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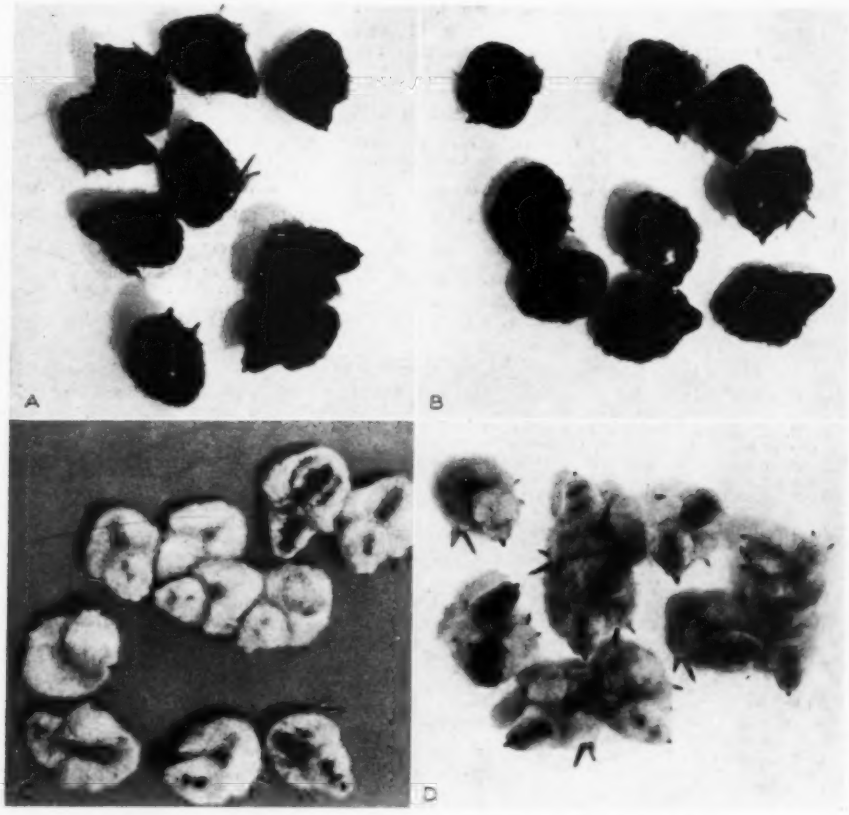

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Genetics of the Japanese
Marriage Among the Deaf
A "Eugenic Split Personality"
A Bent-Finger Gene
Another "Curly" Mutation
Fifty-six Generations of Inbred Mice

VOLUME 27 JANUARY, 1936 NUMBER 1

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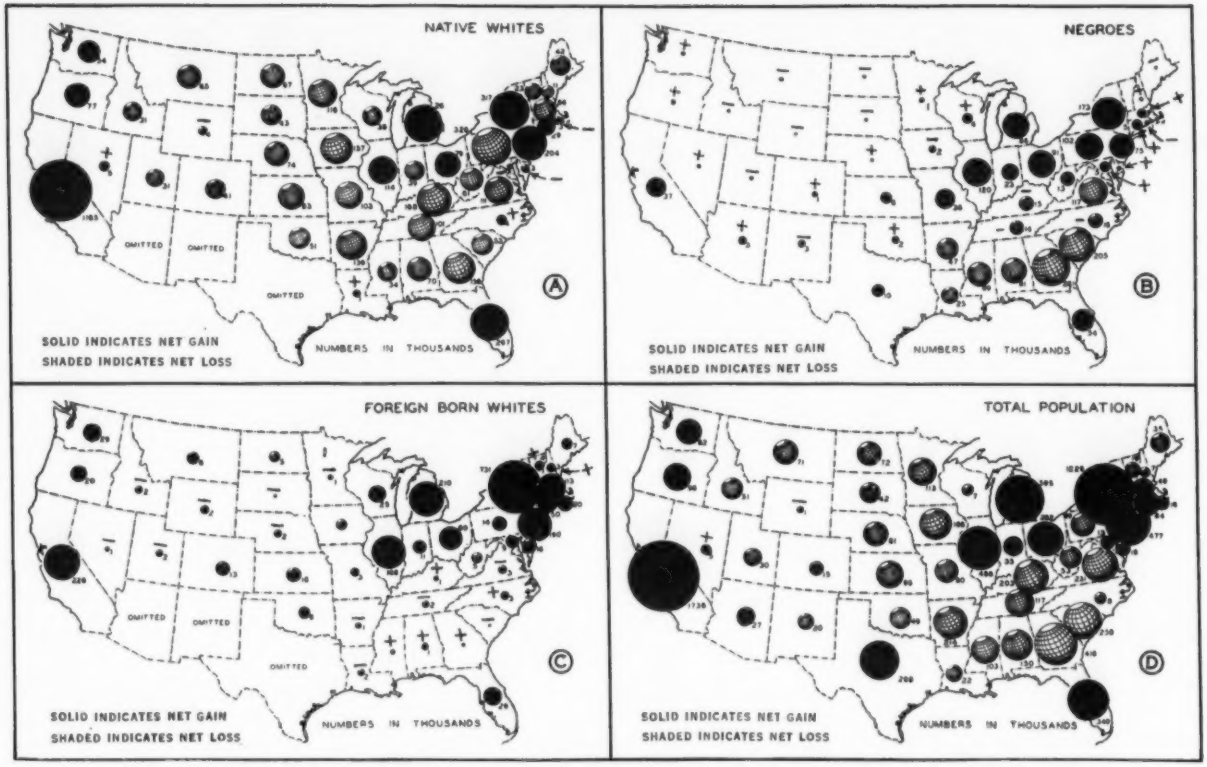


"MIGRATION BALANCE-SHEETS" OF RACIAL GROUPS IN THE UNITED STATES 1920-1930

Frontispiece

The decade 1920-1930 was marked by the greatest internal migration in the history of the United States. Various racial groups were drawn to different parts of the country, and these charts summarize some of the more important of these movements. Except for the movement toward California and Florida, the Migratory trends have all been from rural areas to urban industrial areas. In the last two decades industry has become an increasingly important "magnet of migration," far overshadowing the agricultural attraction of earlier decades. The black circles which symbolize gains are computed on a spherical basis, just as are the "globes" which symbolize losses. Thus the volumes of both the "globes" and the black circles vary as the cube of the diameter. Modified from Thornthwaite.[22]

MIGRATION WITHIN THE UNITED STATES

A Review of Recent Trends

JOSEPH J. SPENGLER
Duke University

WITH few exceptions, until recently, writers on population problems concerned themselves primarily with the problem of population pressure in general. This preoccupation with the concept of inevitable population increase extended well into the post-war period, but about 1927 a changing viewpoint began to be noted, and within the past decade population study has concentrated more and more upon four questions: (a) Will populations of specific countries stop increasing and even begin to decline? (b) What economic, social, and political changes will be occasioned by a zero or a negative rate of growth? (c) To what extent does the *true* long-time rate of natural increase vary according to region, occupational group, and social class, and what are the social, economic, and political implications of these variations? (d) What are the secular and the cyclical tendencies in inter-regional, inter-occupational, and inter-class migration of population? In reviewing the careful studies of inter-regional migration in the United States, prepared under the direction of Professor Carter Goodrich,* and of some of the recommendations relative to American population resettlement policies,† we shall give some attention to the problems listed under (c).

We shall present the findings‡ relating to the problems just mentioned under three heads:

(a) Secular tendencies in internal migration in the United States; (b) cyclical fluctuations in internal migration; (c) present sources of population growth in the United States.

Secular Trends in Internal Migration

A. General Trends, 1850-1930

Thornthwaite's[=] findings relative to secular migratory trends in the United States are five-fold. First, since about 1890, and particularly since the development of the automobile and the extension of all-weather highways, the American population has become more mobile, more sensitive to economic change and to the prospect of deriving advantage from a change in location. The relative amount of migratory movement has thus greatly increased. Whether the rate of increase in migratoriness is declining or approaching an upper limit, only future census findings can disclose.

Second, native white migration has been "overwhelmingly to the west,"§ every state but Delaware, South Caro-

*Three volumes of The Study of Population Distribution have appeared: C. W. Thornthwaite, *Internal Migration in the United States;* C. Goodrich, B. W. Allin, and M. Hayes, *Migration and Planes of Living;* D. B. Creamer, *Is Industry Decentralizing?* University of Pennsylvania Press, 1934-35, $1.00 each.

†As enunciated, for example, in the Goodrich studies; *Report* of National Resources Board; the *Land Policy Review* and supplements, published by AAA; various studies by Dr. O. E. Baker, of the Bureau of Agricultural Economics; and L. C. Gray, et al.[7]

‡Much material on these problems has been worked up by Lorimer and Osborn[16] by the staff of the Milbank Memorial Fund (New York); by W. S. Thompson and P. K. Whelpton of the Scripps Foundation; and by independent scholars.

§Thornthwaite is not concerned with whether or not this westward migration improved the lot of the migrants, or served to draw off the "surplus" population of Eastern urban centers and hence to preserve wage scales and the standard of living. Goodrich and Davidson[8] find that the nineteenth century writers who supported this proposition offer no proof. Two other recent analyses support a negation conclusion.[22]

are the "globes" which symbolize losses. Thus the volumes of both the "globes" and the black circles vary as the cube of the diameter. Modified from Thornthwaite.[22]

lina, and Nevada having contributed at least 10,000 to the westward movement. This movement has followed three main parallel lines, running from the South to southern California, from Pennsylvania through the Middle West to northern California, and from the Old Northwest to Washington and Oregon. Relatively unimportant minor northward currents have run into the Pacific Northwest, the lower lake states, and New York and New Jersey; two minor currents have run into Florida. As we shall presently indicate, however, with the increasing preponderance of industry over agriculture, the westward drift has, except for the pull of California, steadily diminished, and presumably will diminish even more as the California pull exhausts itself.

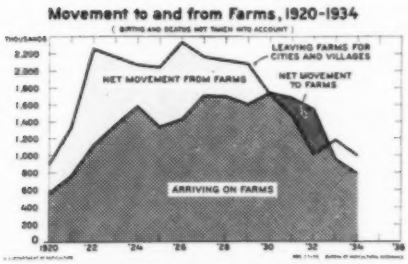
Third, negro migration, which prior to 1890 was local and largely confined within the South, has been predominantly northward to the industrial cities: from the Atlantic states to New York, Philadelphia, Baltimore and Washington; from Georgia, Alabama, and Tennessee to Cleveland and Detroit; from Mississippi, Tennessee, Alabama, Arkansas, and Louisiana to Chicago and St. Louis.

Fourth, during the late Nineteenth Century, industrial expansion became for native whites an increasingly powerful population-attracting force as compared to agricultural extension, and since about 1910 has been dominant as a migrant-pulling force. In general, according to Thornthwaite, two types of migration have taken place in the United States: that which brought agricultural development and that which followed industrial expansion in all of its manifestations. The "migration history of the prevailingly agricultural areas" has quite uniformly three distinct phases. (1) The surplus population of an agricultural state or area traceable to net immigration* has increased for about three decades following its initial settlement. (2) This native white surplus has then persisted as a decreasing quantity for about three decades to become converted thereafter into a deficit when the attraction pull ceases to prevent net losses. Thus, by 1850, states admitted to the Union by 1800 had population deficits and states settled after 1800 had population surpluses. (3) Following 1850 and the continual westward movement of the population the number of more easterly agricultural states with deficits increased as, in some instances, did the size of the deficit in states which already had deficits.

Prior to 1910, migration had been dominated by the westward pull of agricultural extension. After that date migration ceased to be agriculturally determined and the westward trend ended except for California, whose peculiar lure is only partly agricultural. Population flowed primarily into the industrialized North Atlantic and to the lake states and, particularly in 1920-30, to Florida†. Industrial expansion was a population-attracting force to some extent as early as 1850-60 when seven states east of the Mississippi River and north of Virginia and Kentucky, and four states south of this area, experienced a net gain in native white immigration. Of the eleven eastern states gaining in 1920-30 all but Florida are industrial. Since 1850 only five states have experienced a continuous net native white immigration: Florida, New Jersey, California, Oregon, and Arizona. It is interesting to note that at times the influx of foreign born immigrants into certain states, particularly into the industrial states, has apparently fostered a net efflux of na-

*Net immigration represents the difference between the number of persons living in a given state but born outside the state, and the number born in the given state but living outside the state. Thornthwaite[22] has checked this measure for the decade 1920-30 against a refined measure based on age-group data and found it quite adequate.

†Thornthwaite measures net migration by the changes in surplus and deficit as described above. Since deaths of immigrants and emigrants alter the surplus or deficit, Thornthwaite's measure indicates "amount of gain and loss" roughly rather than precisely.



THE AGRICULTURAL-INDUSTRIAL BALANCE SHEET

Figure 1

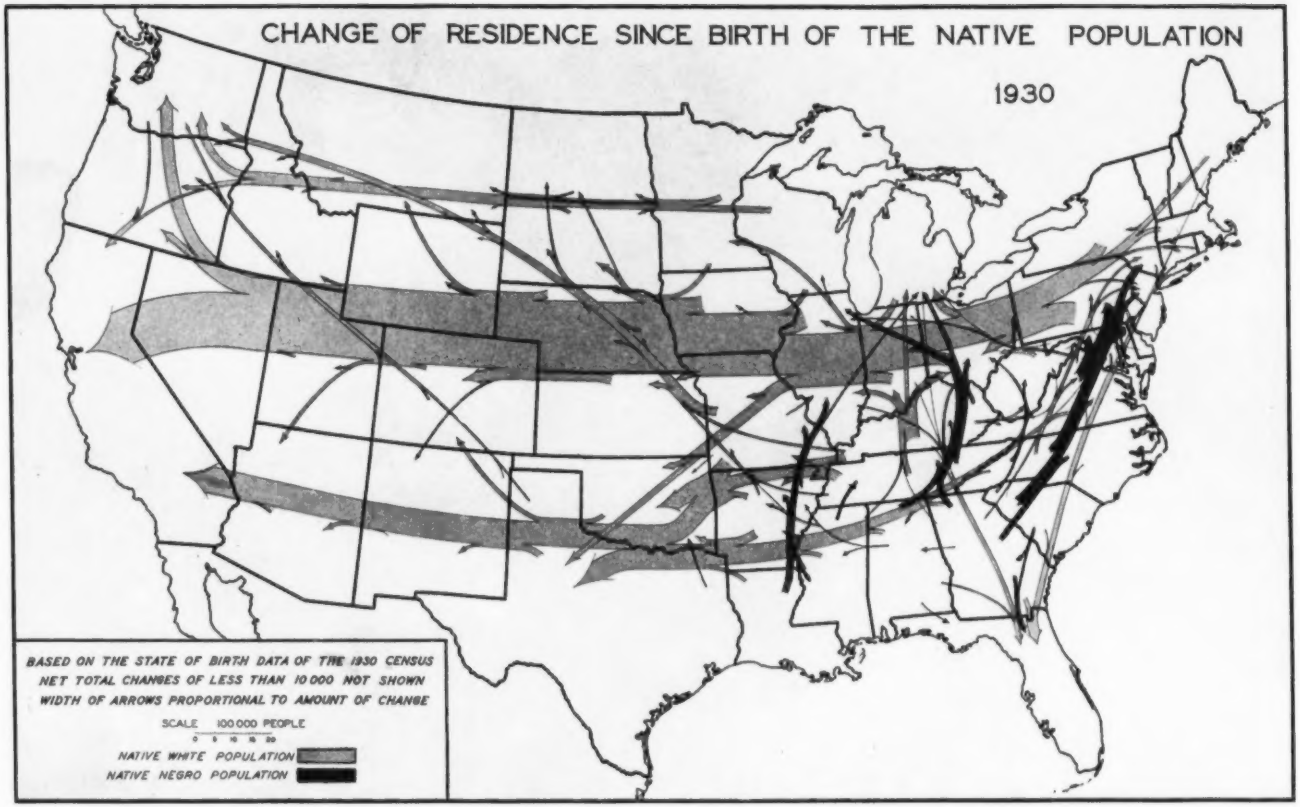
Movement of population to and from the farms of the United States, 1920-34. This chart shows that in 1931 and 1932 a net return of population to the farm from the industrial areas took place. The analysis by the Committee on Population Redistribution shows that this return migration to the farm went to the areas having the least promise of economic betterment. Thus, while the pre-depression migration tended to place people in economically better situations, the migrations during the depression have placed people in "population traps" where their economic situation apparently is worse on the whole than if they had not moved.

In 1933 the movement to farms decreased about 40 per cent; while that from farms rose, exceeding the movement to farms. In 1934 there was a decrease in both movements. The net migration from farms was about 227,000 in 1933 and 211,000 in 1934. The graph is based on estimates made annually by Drs. Galpin and Manny, of the Bureau of Agricultural Economics.

tive whites despite the inherent relative economic attractiveness of such states.[4] Thus Ohio (1850-60), Wisconsin (1880-90), and more recently such states as New York and Pennsylvania have apparently experienced net native white effluxes as a consequence of extensive foreign immigration. In the decade 1920-30 foreign-born immigrants "were located chiefly in the industrial states of the North Atlantic coast, in the Great Lakes region, and in California." Mexican immigration into Texas exceeded the emigration of native whites. It is curious, as noted below, that increase in the negro population (or of relative numerical importance of negroes in particular states) apparently did not have this effect.

Fifth, Thornthwaite's study reveals, as does that of Goodrich, Allin, and Hayes,[5] that "the most significant migration trend in the decade [1920-30] is the movement from the country and the concentration of population in and around the large urban agglomerations." In general, while a few urban areas (chiefly in Massachusetts) lost population and a few rural areas (chiefly in western Kansas, Mississippi, and California) gained, the rural areas gave up population to urban areas. In 1920-29 about 6,000,000 left the farms; of these, about 2.4 million whites and 1.2 million negroes came from the South. In 1930-33 the net return movement to the farms totaled nearly one million. In 1934 a slight net urbanward movement developed. On January 1, 1935, the total rural population (over 32 millions) exceeded that of 1930 by more than two millions, an increase due to rural natural increase and to the post-1929 net farmward migration. In 1935 the number of farms, particularly in poor-land areas and adjacent to large cities, was greater than in 1930. However, judging from the fact that following business recovery in 1922 most rural counties lost population and from the fact that with business improvement in 1933 and 1934 rural counties in several industrial areas began to give up population, it seems to follow "that a large part of the people now on farms will move to the cities as soon as industrial employment is available for them." Presumably the degree to which the cityward drift will be uniform will depend, as in 1922-29, upon the degree to which "the rate of improvement in industrial activity in relation to farm prices" is uniform.

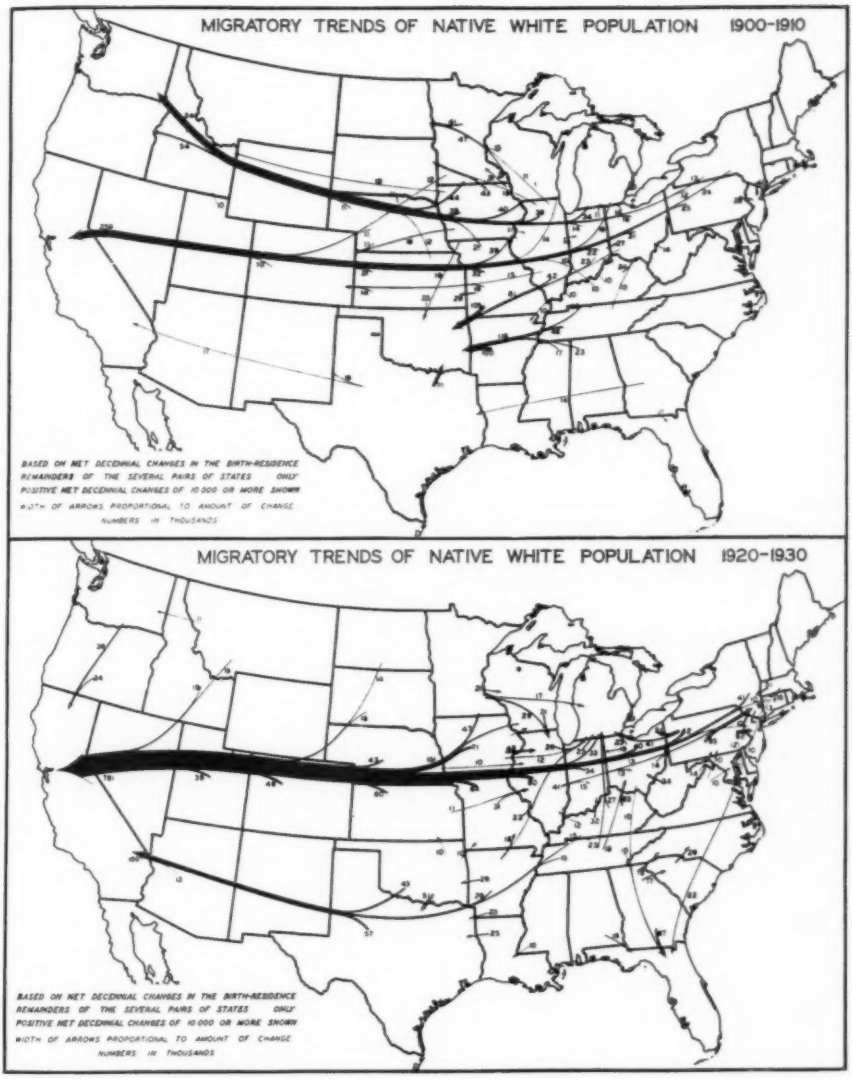
While Thornthwaite has not tried to determine the trend in the age and the sex composition of native white migrants, he confirms the view that cities attract the young rather than the old and to some extent females rather than males. Younger people preponderate too in the migration from declining industrial communities. Growing industrial communities such as Detroit are marked, especially since 1920, by a net efflux of


CHANGE OF RESIDENCE SINCE BIRTH OF THE NATIVE POPULATION
1930
BASED ON THE STATE OF BIRTH DATA OF THE 1930 CENSUS
NET TOTAL CHANGES OF LESS THAN 10 000 NOT SHOWN
WIDTH OF ARROWS PROPORTIONAL TO AMOUNT OF CHANGE
SCALE 100 000 PEOPLE
0 5 10 15 20
NATIVE WHITE POPULATION
NATIVE NEGRO POPULATION

CALIFORNIAWARDS THE COURSE OF POPULATION MAKES ITS WAY

Figure 2

Modified chart from Thornthwaite,[22] showing change of residence of the native born population as of the year 1930. This chart covers the existing situation at that time and not migration during any particular decade. Thus any surviving child forty-niners living in California are counted as well as children arriving from other states by train, auto, or airplane as late as 1929. This summary of migration trends is to be compared with the maps shown on the opposite page, which emphasize the fact that westward migration (except to California) has virtually ceased. The minor secondary streams of migration are directed toward the industrial areas, as are the streams of negro migration to northern industrial states.


MIGRATORY TRENDS OF NATIVE WHITE POPULATION 1900-1910
BASED ON NET DECENNIAL CHANGES IN THE BIRTH-RESIDENCE REMAINDERS OF THE SEVERAL PAIRS OF STATES ONLY POSITIVE NET DECENNIAL CHANGES OF 10 000 OR MORE SHOWN
WIDTH OF ARROWS PROPORTIONAL TO AMOUNT OF CHANGE
NUMBERS IN THOUSANDS
MIGRATORY TRENDS OF NATIVE WHITE POPULATION 1920-1930
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WIDTH OF ARROWS PROPORTIONAL TO AMOUNT OF CHANGE
NUMBERS IN THOUSANDS

END OF THE HOMESTEAD ERA

Figure 3

Comparison of migratory trends of the native white population in the first decade of the twentieth century and in the third decade. As late as 1900 the settling of the West (Texas and Oklahoma) was still taking place. Twenty years later any definite migratory trends toward these regions had greatly declined, and the main stream of migration was to California. Secondary streams were converging toward the industrial areas. Modified from Thornthwaite.[22]

California) has virtually ceased. The minor secondary streams of migration are directed toward the industrial areas, as are the streams of negro migration to northern industrial states.

TABLE I. Correlation between rank of States in Relative Net Native White Immigration in 1920-30 and Rank of States in Per Capita Income, Culture, etc.

Relative net Native White Immigration in 1920–30	Number of states among the 12 and 24 highest and lowest respectively, as ranked in columns (2) to (16) exclusive of (4), which also appear among the 12 and 24 highest and lowest states as ranked in (4) according to relative net native white immigration in 1920–30													Number of states in 12 and 24 highest and lowest set in columns (2) to (16) exclusive of (4) which, on the basis of probability, should also appear among the 12 and 24 highest and lowest in column (4)
	Permanent Replacement Ratio	Per cent Increase in Total Population in 1920–30	Per Capita Income in 1929	Economic Rank	Per cent of Population on Relief	Cultural Rank: Lorimer-Osborn Index	Cultural Rank: Henderson-Angoff Index	Degree of Industrialization			Per cent Increase in Negro Population in 1920–30	Per cent which Negroes comprise of Total Population in 1930	Per cent which Foreign Born comprise of Total Population in 1930	
(4)	(2)	(3)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
12 highest include	$1H_{12}$ $6L_{12}$	$8H_{12}$ $0L_{12}$	$6H_{12}$ $0L_{12}$	$7H_{12}$ $0L_{12}$	$2H_{12}$ $0L_{12}$	$3H_{12}$ $1L_{12}$	$6H_{12}$ $1L_{12}$	$8H_{12}$ $1L_{12}$	$7H_{12}$ $2L_{12}$	$5H_{12}$ $1L_{12}$	$8H_{12}$ $1L_{12}$	$8H_{12}$ $1L_{12}$	$8H_{12}$ $1L_{12}$	$3H_{12}$ $3L_{12}$
24 highest include	$8H_{24}$ $16L_{24}$	$16H_{24}$ $6L_{24}$	$16H_{24}$ $8L_{24}$	$16H_{24}$ $8L_{24}$	$8H_{24}$ $16L_{24}$	$12H_{24}$ $12L_{24}$	$14H_{24}$ $10L_{24}$	$16H_{24}$ $6L_{24}$	$17H_{24}$ $7L_{24}$	$16H_{24}$ $6L_{24}$	$17H_{24}$ $7L_{24}$	$12H_{24}$ $12L_{24}$	$14H_{24}$ $10L_{24}$	$12H_{24}$ $12L_{24}$
12 lowest include	$4H_{12}$ $0L_{12}$	$0H_{12}$ $6L_{12}$	$0H_{12}$ $3L_{12}$	$0H_{12}$ $2L_{12}$	$8H_{12}$ $1L_{12}$	$3H_{12}$ $2L_{12}$	$5H_{12}$ $1L_{12}$	$0H_{12}$ $4L_{12}$	$0H_{12}$ $5L_{12}$	$0H_{12}$ $4L_{12}$	$0H_{12}$ $6L_{12}$	$1H_{12}$ $6L_{12}$	$2H_{12}$ $2L_{12}$	$3H_{12}$ $3L_{12}$
24 lowest include	$16H_{24}$ $8L_{24}$	$6H_{24}$ $16L_{24}$	$8H_{24}$ $16L_{24}$	$8H_{24}$ $16L_{24}$	$16H_{24}$ $8L_{24}$	$12H_{24}$ $12L_{24}$	$10H_{24}$ $14L_{24}$	$6H_{24}$ $18L_{24}$	$7H_{24}$ $17L_{24}$	$6H_{24}$ $18L_{24}$	$7H_{24}$ $17L_{24}$	$12H_{24}$ $12L_{24}$	$10H_{24}$ $14L_{24}$	$12H_{24}$ $12L_{24}$
16* highest include	$9H_{16}$ $3L_{16}$	$11H_{16}$ $1L_{16}$	$10H_{16}$ $2L_{16}$	$9H_{16}$ $2L_{16}$	$5H_{16}$ $5L_{16}$	$6H_{16}$ $8L_{16}$	$9H_{16}$ $4L_{16}$	$9H_{16}$ $3L_{16}$	$9H_{16}$ $1L_{16}$	$9H_{16}$ $1L_{16}$	$11H_{16}$ $2L_{16}$	$3H_{16}$ $4L_{16}$	$7H_{16}$ $3L_{16}$	$5H_{16}$ $5L_{16}$

*These 16 States experienced an absolute net native white immigration in 1920-30.

Sources: Columns (2)-(13) are derived from Table III; columns (14)-(16) are derived from the Fifteenth Census, 1930. Probable frequencies in (17) are obtained as follows: 12:48::3:12; 24:48::12:24; 16:48::5 1/3:16. *Explanation* of Table I: Column (4) includes in each cell the designated number of states ranking highest or lowest in net native white immigration; columns (2) to (16) include in each cell the number of states falling both within either the upper or lower 12 and 24 states in (4) and within the designated upper and lower 12 and 24 in (2) to (16). Thus a comparison of columns (4) and (6) reveals that the 12 states ranking highest in net native white immigration in 1920-30 include 6 of the 12 ranking highest and none of the 12 ranking lowest in per capita income; that the 24 lowest in (4) include 8 of the 24 ranking highest and 16 of the 24 ranking lowest in per capita income; that the 16 ranking highest in (4) include 10 of the 16 ranking highest and 2 of the 16 ranking lowest in per capita income. Column (17) indicates that, on the basis of probability, any 12, 24, or 16 states in (4) would include but 3, 12, and 5 1/3 states respectively of any given group of 12, 24, or 16 states in (6). Accordingly, since the observed frequency of correspondence between the states in column (4) and those in column (6) is greater and less than one would anticipate on the basis of probability, one must conclude that migrants tend to move from states where per capita income is relatively low to states where per capita income is relatively higher. Where the observed frequencies in certain columns, such as (9) and (15), do not differ markedly from the expected frequency given in column (17), it is to be presumed that there is no negative or positive causal association between the rank of states in column (4) and the rank of the same states in columns such as (9) and (15).

TABLE II. Correlation Between Rank of States in Net Replacement of Native White Population in 1930 and Rank of States in Per Capita Income, Culture, etc.

Permanent Replacement Ratio of Native White Population in 1930	Number of states among the 12 and 24 highest and lowest respectively, as ranked in columns (3) to (16), which also appear among the 12 and 24 highest and lowest as ranked in (2) according to permanent replacement ratio of native white population													Number of states in 12, and 24 highest and lowest set in columns (3) to (16) which, on the basis of probability, should also appear among the 12 and 24 highest and lowest in column (2)
	Per cent Increase in Total Population in 1920–30	Relative Net Native White Immigration 1920–1930	Per Capita Income in 1929	Economic Rank	Per cent of Population on Relief	Cultural Rank: Lorimer-Osborn Index	Cultural Rank: Henderson-Angoff Index	Degree of Industrialization			Per cent Increase in Negro Population in 1920–30	Per cent which Negroes comprise of Total Population in 1930	Per cent which Foreign born comprise of Total White Population in 1930	
(2)	(3)	(4)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
12 highest include	$8H_{12}$ $4L_{12}$	$1H_{12}$ $4L_{12}$	$0H_{12}$ $9L_{12}$	$0H_{12}$ $7L_{12}$	$6H_{12}$ $8L_{12}$	$0H_{12}$ $6L_{12}$	$1H_{12}$ $9L_{12}$	$0H_{12}$ $8L_{12}$	$0H_{12}$ $6L_{12}$	$0H_{12}$ $7L_{12}$	$0H_{12}$ $8L_{12}$	$6H_{12}$ $3L_{12}$	$6H_{12}$ $6L_{12}$	$3H_{12}$ $3L_{12}$
24 highest include	$12H_{24}$ $12L_{24}$	$8H_{24}$ $16L_{24}$	$5H_{24}$ $19L_{24}$	$8H_{24}$ $22L_{24}$	$13H_{24}$ $11L_{24}$	$8H_{24}$ $16L_{24}$	$4H_{24}$ $20L_{24}$	$5H_{24}$ $19L_{24}$	$6H_{24}$ $16L_{24}$	$5H_{24}$ $19L_{24}$	$8H_{24}$ $16L_{24}$	$12H_{24}$ $9L_{24}$	$8H_{24}$ $16L_{24}$	$12H_{24}$ $12L_{24}$
12 lowest include	$0H_{12}$ $0L_{12}$	$0H_{12}$ $0L_{12}$	$1OH_{12}$ $0L_{12}$	$9H_{12}$ $0L_{12}$	$0H_{12}$ $8L_{12}$	$5H_{12}$ $0L_{12}$	$8H_{12}$ $0L_{12}$	$7H_{12}$ $0L_{12}$	$7H_{12}$ $0L_{12}$	$6H_{12}$ $0L_{12}$	$4H_{12}$ $0L_{12}$	$0H_{12}$ $8L_{12}$	$6H_{12}$ $0L_{12}$	$3H_{12}$ $3L_{12}$
24 lowest include	$12H_{24}$ $12L_{24}$	$1OH_{24}$ $8L_{24}$	$19H_{24}$ $5L_{24}$	$20H_{24}$ $2L_{24}$	$11H_{24}$ $13L_{24}$	$16H_{24}$ $8L_{24}$	$20H_{24}$ $4L_{24}$	$19H_{24}$ $5H_{24}$	$16H_{24}$ $6L_{24}$	$8H_{24}$ $19L_{24}$	$14H_{24}$ $8L_{24}$	$9H_{24}$ $13L_{24}$	$14H_{24}$ $8L_{24}$	$12H_{24}$ $12L_{24}$

See under Table I for sources. Explanation of Table II: similar to that of Table I. For example, comparison of column (2) with column (6) reveals that among the 12 states ranking highest in permanent net replacement ratio there are 7 of the 12 ranking lowest and none of the 12 ranking highest in per capita income; among the 24 lowest in (2) there are 19 and 5 respectively of the 24 highest and 24 lowest in per capita income. According to (17) the respective frequencies should be 3 and 12. Whence it follows that high rank in net fertility is associated with low rank in per capita income, and low rank in fertility with high rank in per capita income.

persons aged more than 45 years, attributable to the fact that a man's employability in urban areas falls sharply after 45. Data for Detroit indicate too that "freedom from family responsibility" is an important cause of "the high degree of mobility of a large fraction of our population." Thornthwaite concludes that so far as the young people are concerned "the recent retreat to the refuge areas on sub-marginal land is merely temporary provided society can work itself out of the depression."

B. Trends in 1920-30

In Table I we present data which indicate the relation of certain factors to

TABLE III. States in Order of Rank in Demography, Migration, and Cultural and Economic Status.

State	Percent Replacement Ratio of Native Whites in 1930	Per cent Increase in Total Population 1920-30	Relative net Native Migration 1920-30 (in Per cent)	Relative net Negro Immigration 1920-30 (in Per cent)	Per Capita Income in Dollars in 1929	Economic Rank	Per cent of Population on Relief in February 1935	Cultural Rank: Lorimer-Osborn Index	Cultural Rank: Jenson-Angoff Index	Rank in Relative degree of Industrialization of the population about 1929		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
West Virginia	1.61 (1)	10.1 (9-10)	-5.2 (32)	+10.5 (B)	472 (39)	36	84 (6-7)	38	37	16	17	12-13
No. Carolina	1.57 (2)	22.9 (7)	+2.4 (13)	+	333 (46)	42	11 (42-44)	45	42	42	35	31-32
New Mexico	1.53 (3)	17.5 (13)	+4.1 (10)	-3.4 (C)	467 (38)	34	31 (2-3)	39	41	39	41	39
Alabama	1.54 (4)	12.7 (22)	-2.1 (27)	-6.2 (C)	285 (44)	45	15 (38-37)	42	47	43	37	41
Utah	1.38 (5)	15.0 (21)	-11.5 (48)	-	582 (26)	20	25 (5)	17	6	20-21	16	21
Kentucky	1.52 (6-7)	8.2 (32)	-5.0 (31)	+0.4 (B)	370 (41)	39	19 (13-14)	40	39	37	34	31-32
Arkansas	1.52 (6-7)	5.0 (38)	-13.8 (45)	-17.0 (D)	308 (46)	47	21 (9-10)	44	45	47	45	45
Mississippi	1.49 (8)	12.2 (24)	-1.7 (23-24)	-8.7 (C)	286 (47)	46	14 (38-34)	46	46	46	46	46
So. Carolina	1.46 (9)	9.3 (43)	-3.2 (29-29)	-17.2 (D)	256 (48)	48	16 (21-26)	44	44	44	40	42
No. Dakota	1.43 (10)	5.3 (39)	-19.3 (47)	+	421 (39)	33	21 (2-3)	15	34	44	40	47
Idaho	1.40 (11)	3.0 (44)	-10.6 (46)	-	507 (34)	28	21 (9-10)	18	32	41	31	36
Tennessee	1.39 (12)	11.9 (25)	-1.7 (23-24)	-0.2 (C)	335 (43)	41	15 (35-37)	41	40	30	33	34
Oklahoma	1.35 (13-14)	18.1 (9-10)	-9.6 (38)	-9.4 (D)	463 (33)	40	27 (4)	37	31	32	44	36
Georgia	1.35 (13-14)	0.4 (47)	-7.0 (35)	-17.6 (D)	337 (42)	44	12 (39-41)	43	43	40	38	40
Virginia	1.34 (15)	4.9 (41)	-3.2 (29-29)	-9.3 (D)	422 (38)	37	9 (47)	36	38	38	39	35
Louisiana	1.32 (16)	16.9 (14)	-2.4 (26)	-7.9 (C)	420 (37)	43	14 (38-41)	47	48	34	36	37
So. Dakota	1.29 (17)	5.8 (31)	+14.1 (44)	+	412 (40)	31	30 (1)	23	30	45	47	44
Maine	1.22 (18-19)	3.8 (43)	-1.8 (25)	+	609 (25)	30	11 (42-44)	25-	21	14	25	16
Vermont	1.22 (18-19)	8.0 (46)	+0.3 (16)	-	606 (26)	25	10 (45-46)	8	27	26	21	22
Wyoming	1.21 (20)	16.0 (17)	-8.5 (36)	-	772 (12)	22	17 (22)	6	20	20	23	26
Florida	1.17 (21)	51.6 (2)	+338.9 (2)	+24.9 (B)	522 (30)	32	16 (21-26)	32	35	20-21	29	29
Montana	1.16 (22-23)	-2.1 (48)	-21.3 (48)	-	661 (18)	27	21 (9-10)	9	20	33	28	28
Texas	1.16 (22-23)	24.9 (6)	-0.1 (17)	-2.0 (C)	509 (32)	33	20 (11-12)	28	26	25	43	43
Michigan	1.14 (24-25)	32.0 (3)	+9.1 (4)	+150.0 (A)	811 (9)	11	15 (37-31)	20	4	11	3	6
Nebraska	1.14 (24-25)	6.3 (36-37)	-13.1 (43)	-7.7 (C)	611 (21)	21	16 (21-26)	19	22	26	42	44
Wisconsin	1.13 (26)	11.7 (26)	-1.3 (21)	+100.0 (A)	636 (20)	19	16 (21-26)	26	15	24	13	18-19
Kansas	1.12 (27)	6.3 (36-37)	-11.0 (41)	+	595 (29)	24	19 (13-14)	29	23	29	25	23
Iowa	1.11 (28)	2.8 (45)	-9.7 (39)	-10.5 (D)	674 (24)	17	13 (42-44)	16	11	31	18	15
Indiana	1.09 (29)	10.5 (27-28)	+1.3 (14)	+23.5 (B)	698 (23)	12	16 (21-26)	29	14	15	10	11
Pennsylvania	1.08 (30-31)	10.5 (27-28)	-3.4 (30)	+30.5 (A)	752 (13)	9	19 (13-14)	24	25	6	5	4
Minnesota	1.08 (30-31)	7.4 (33)	-8.8 (37)	+	683 (27)	13	13 (37-31)	12	16	27	20	20
Arizona	1.07 (32)	30.5 (4)	+17.5 (3)	+25.0 (B)	711 (17)	29	30 (11-12)	30	33	19	12	17
Colorado	1.05 (33)	10.2 (30)	-10.8 (40)	-9.1 (D)	686 (19)	15	24 (6-7)	7	5	35	30	27
New Hampshire	1.04 (34)	5.0 (40)	-1.1 (19)	+	817 (21-22)	23	10 (45-46)	11	24	9	14	7
Maryland	1.02 (35)	12.5 (23)	+2.7 (11)	+8.2 (B)	731 (16)	16	13 (35-37)	31	29	10	15	14
Ohio	1.01 (36)	10.4 (29)	+3.2 (9)	+44.3 (A)	748 (14)	10	16 (19-19)	10	13	8	11	10
Missouri	1.00 (37)	6.6 (35)	-6.0 (34)	+19.1 (B)	617 (21-22)	26	16 (19-19)	33	19	23	24	23-24
Delaware	.95 (38-39)	9.4 (34)	+0.6 (15)	+	891 (4)	14	9 (48)	34	28	13	19	18-19
Nevada	.95 (38-39)	17.6 (12)	+7.8 (6)	+	947 (3)	4	15 (37-31)	21	18	17	9	15
Illinois	.89 (40-41)	17.7 (11)	+2.6 (12)	+39.1 (A)	928 (5)	5	15 (37-31)	22	7	7	7	8
Rhode Island	.89 (40-41)	13.7 (20)	-1.4 (22)	+11.8 (B)	810 (10)	8	12 (39-41)	14	10	1	2	3
Washington	.88 (42)	15.2 (19)	-1.8 (24)	-	801 (11)	12	14 (38-34)	1	10	16	30	30
Oregon	.86 (43)	21.8 (8)	+5.1 (8)	-	743 (15)	14	15 (37-31)	4	9	22	27	23-24
Massachusetts	.84 (44-46)	10.3 (28)	-4.0 (31)	-0.3 (C)	873 (6)	4	16 (19-19)	3	1	2	6	9
New Jersey	.84 (44-46)	28.1 (5)	+8.3 (5)	+55.3 (A)	932 (4)	7	16 (21-26)	27	17	5	4	5
Connecticut	.84 (44-46)	16.4 (15)	+0.8 (15)	+20.3 (B)	883 (7)	2	12 (39-41)	5	3	3	1	2
New York	.79 (47)	21.2 (9)	+4.3 (9)	+78.0 (A)	1208 (1)	3	16 (19-19)	13	8	4	8	1
California	.69 (48)	65.7 (1)	+43.4 (1)	+84.2 (A)	1019 (2)	1	14 (38-39)	2	2	12	10	10-19

Sources of Data in Table III: Columns 2, 9 are taken from Lorimer and Osborn,[16] pp. 358-59, 147; columns 4 and 5 are computed from Thornthwaite[22] plates II and III, and from the Fifteenth Census, Population, Vol. 2, pp. 41-45; estimates of per capita income exclusive of profits from sale of property, given in column 6, are from M. LEVIN, H. G. MOULTON and C. W. WARBURTON, *American's Capacity to Consume*, Washington, 1934, p. 174; 7 and 10 are from H. MENCKEN and C. ANGOFF, *American Mercury*, Vol. 24, 1931 p. 356; 18 is taken from *Monthly Report* of Federal Emergency Relief administration, March 1-31, 1935; 11-13 are computed from Fifteenth Census, Vols. 4, Vol. 22, p. 93; Vol. 25, p. 47; other data are from Fifteenth Census Vol. 1. Explanations: (4) is computed by dividing into the net native white immigration or emigration in 1920-30 the adjusted native white population of 1920; (5) is computed by dividing net negro immigration of 1920-30 by the native negro population of 1920; (9) gives rank of states in percentage of total (male and female) population engaged in occupations other than agriculture, forestry, and fisheries; (10) gives average rank of states in (value added by manufacture plus value of product in mines and quarries in 1929 divided by total population); (11) gives average rank of states in (9), (10), and proportion of total (male and female) gainfully employed population engaged in manufacturing and extraction of minerals. Numbers in parentheses give order of rank in columns 2, 3, 4, 6, 7; the letters A, B, C, D in (5) give the states quartile ranking in relative net negro immigration.

net relative native white immigration in 1920-30. The following conclusions are suggested:

(1) Factors favorable to net native white immigration are also the factors favorable, on the balance, to increase of population in general. For (see column 3) the states ranking relatively high in relative net native white immigration in 1920-30 include an unduly large proportion of the states marked by relatively high rates of increase in total population in the same decade and an unduly small proportion of states ranking relatively lowest in rate of total population growth; and conversely states ranking low in relative net native white immigration are also states ranking relatively low in rate of total population growth in 1920-30.

(2) Relatively high or low rates of increase in the total negro population are not unfavorable and favorable respectively to native white immigration. Rather the factors favorable or unfavorable respectively to native white immigration are also favorable or unfavorable to the increase of the negro population (see column 14).*

(3) The proportion of negroes in the total population (column 14) exercises no appreciable attractive or repelling influence upon native white migrants.

(4) The proportion of foreign-born (column 16) in the white population does not deter native white immigration. Rather, the factors which originally attracted and continue to attract foreign-born immigrants, also attract native white immigrants.

(5) In general native white migrants tend to move from states where the levels of per capita income and of economic conditions of the population are relatively lower to states where the corresponding levels are relatively higher. The attracting influences in relatively higher level states may be slightly greater than the repelling influences in relatively lower level states. (See column 6-7.)

(6) Native white migrants have tended to some extent to move from places of relatively less to places of relatively more economic security (column 8).

(7) The figures in columns 9 and 10 reveal no marked tendency on part of migrants to move from areas ranking relatively lower in culture to areas ranking relatively higher. However, Goodrich's data (see below) and, assuming that culture correlates positively and closely with economic status, the data in columns 6 and 7 suggest that migration tends to be cultureward.

(8) The direction of native white migration has been predominantly from states in which agriculture, forestry, and fishing are the major pursuits to states in which these pursuits are relatively unimportant and industrial pursuits (especially manufacturing and the extraction of minerals) are important (columns 11-13).

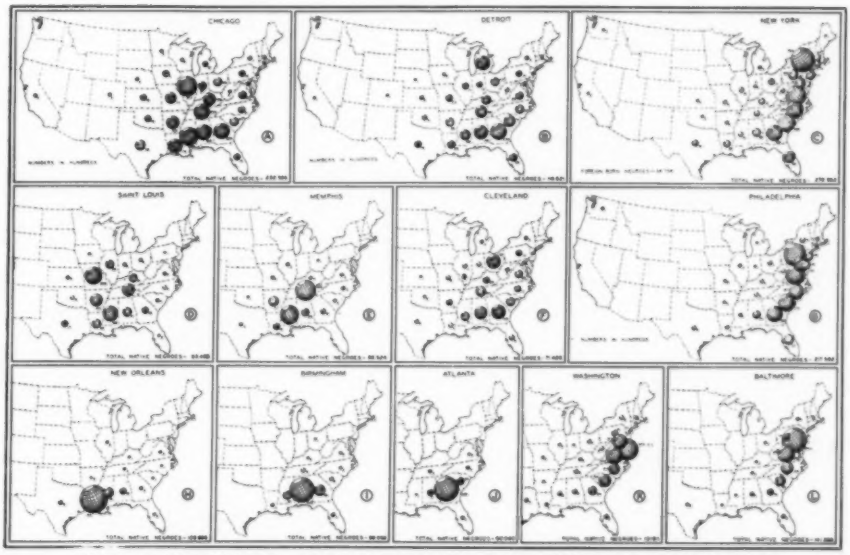
(9) Native white migration has been predominantly from states in which the true rate of natural increase in the native white population is relatively high to states in which the true rate is relatively low (column 2).

C. Future Trends in Internal Migration

Thornthwaite's tracing of the past secular trend in internal migration raises the question whether or not the future trend will continue that under way in, say, 1900-1930. The answer depends upon the extent to which the distribution of population in a given area determines the distribution of industry and the extent to which the distribution of industry determines the distribution of population in that same area. Given an area such as Europe, which is divided into a number of sovereign regions, the distribution of population over the entire area will determine to some extent the distribution of industry, each branch of which will tend to settle in those parts where its unit costs of operation are at a comparative minimum; for impediments will exist to the free movement of population (e. g., immigration laws) and possibly to the free movement of capital.† Within a country such as the United States, how-

*This conclusion is further corroborated by the data in column (5) of Table III. Of the 32 states selected on the basis of their having experienced a relatively and/or absolutely important net immigration or net emigration the 8 states highest in relative net negro immigration in 1920-30 include 5 of the 8 highest and none of the 8 lowest in relative net native white immigration; the 16 highest include 12 and 4 respectively of the 16 highest and the 16 lowest in relative net native white immigration: the 8 lowest include none and 5 respectively of the 8 highest and 8 lowest in relative net native white immigration; the 16 lowest include 4 and 12 respectively of the 16 highest and 16 lowest in relative net nation white immigration.

†We are not here concerned with tariff policies which likewise will affect the distribution of industry over a nation-studded area such as Europe as well as the type of industry located in any given country.



THE NORTHWARD MIGRATION OF THE NEGRO POPULATION

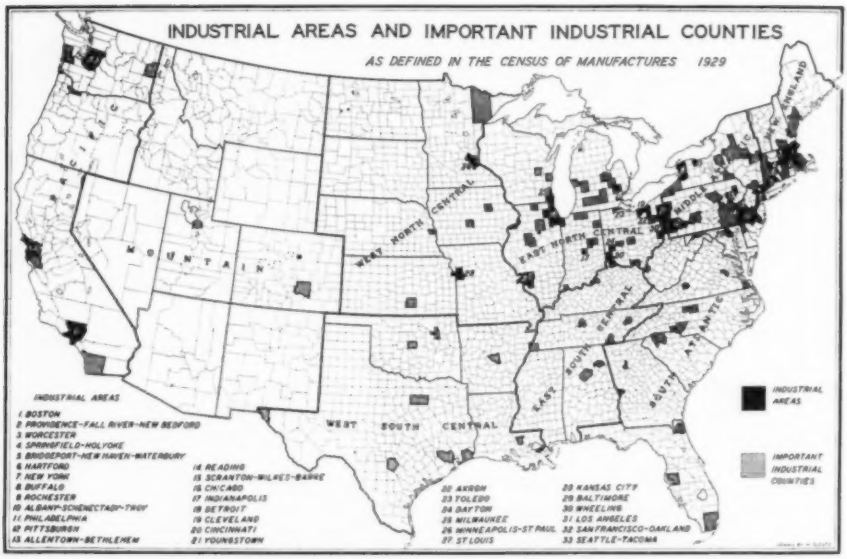
Figure 4

The spheres of various sizes show the state of birth of native negroes in twelve American cities in 1930. The numbers under the spheres are in hundreds and show migration from each state to the city in question. Thus the negro population of New Orleans is practically all native to Louisiana, while that of Chicago is drawn from all of the southern states. More of the negro population of Detroit came from Georgia than was native to the city. These charts visualize one of the great mass migrations in the history of our country. From Thornthwaite.[22]

ever, in which no impediments exist to obstruct the flow of capital and labor from one part of the country to another, the distribution of industry will be determined primarily by the distribution of industrial and natural advantages and secondarily by the prevailing structure of freight and transportation rates. The distribution of the producing population and hence of the consuming population and of the entire population will be determined predominantly if not wholly by the distribution of industry. Accordingly then, since the distribution of the American population is, and will be, determined by the distribution of industry, a forecast of the migratory trends of the former involves a forecast of the migratory trends of the latter.

If we ignore the possible effects of unforeseen changes in the structure of transportation, in the level of domestic and foreign tariff walls, in internal economic policies such as the AAA crop control schemes, and in such industrial monopoly practices as make for an uneconomic location of industry, past and current trends suggest two definite long run courses of development. First, the drift from agricultural areas and occupations will presumably continue. Second, there will be no great tendency for industry to spread away from its present areas of location.

The drifts from agricultural areas and occupations will be governed by the extent to which chemical advances can elevate the demand for organic products and the extent to which a planned ecological and technological approach to agricultural production can increase output per head. If, as the evidence seems to show[23, 9, 1] the latter force is



THREE-QUARTERS OF THE WAGE JOBS IN 200 COUNTIES

Figure 5

Two hundred counties (shown shaded and black above) of the three thousand in the United States include all the important industrial areas and 74 per cent of the wage jobs in American manufactures. About half of the American population in 1930 lived in these 200 industrial counties, and about 84 per cent of the total rural population lived in the other 2,800 counties. In recent decades the migratory trends of the American population have been definitely toward these industrial areas. Since the same forces presumably will be operative in the immediate future, the question of whether industry is likely to remain concentrated or to show a tendency to diffuse throughout the countryside is of considerable importance in population planning. Creamer's exhaustive study gives little ground for anticipating a decentralization of industry. There may be an increasing tendency for industrial organizations to locate on the periphery of existing industrial areas, but the indications are that no significant migration of industry into the white areas of the above map is likely to occur. Rather it seems likely that 250 counties will become industrially important in the not far distant future instead of the 200 counties which now constitute the industrial heart of the United States. From Creamer, D. B., *Is Industry Decentralizing?*

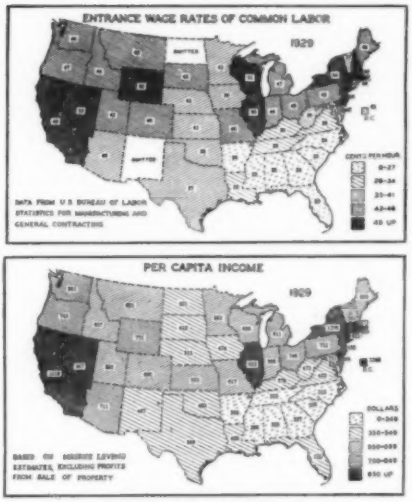
the more powerful, the drift from the farm will continue.*

In a recent analysis[3] it is noted that it is not yet clear whether industrial localization has become stabilized:

A majority of the food products industries studied exhibited a considerable degree of shifting of the area of concentration over the period. Cotton manufactures . . . were still on the move from New England to the South [in 1927-1929]. Wool manufactures are stable but the silk and rayon industry is moving into New England and to the South to some extent as it develops in importance. The important iron and steel industry (the basic industry) is as yet unsettled in location, and the fabricating industries using this metal as their principal material show no indication, with the exception of textile machinery, hardware, and possibly automobiles, of becoming settled in one or more definite areas.

Tracy Thompson, on the basis of a study covering the same period, con-

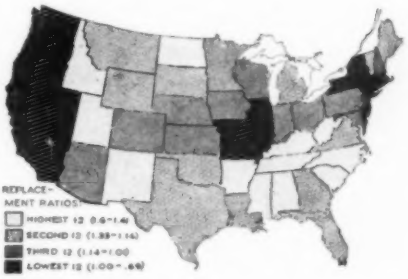
*While the drift from the farm will continue to influence the volume of commercial and professional population serving agriculturalists, local influences will govern the specific location of this auxiliary population. See for example Lively[14], Smith[21], Kolb and Brunner.[12]



ECONOMIC INDICES

Figure 6

Wage rates of labor and per capita income were two of the criteria used by Goodrich, Allin and Hayes in determining what effects migratory trends of recent years had had on the economic welfare of the American people. These maps are interesting as comparison with the Frontispiece and Figure 1. Figure 7 brings into sharp relief the inverse relation between economic status and effective reproductive rates. From Goodrich, Allin and Hayes, *Migration and Places of Living.*



REPLACEMENT INDICES

Figure 7

The states arranged in quartile groups, according to the permanent replacement ratios of the native white population in 1930, show rather strikingly the inverse relation between economic status and "reproductive efficiency." The eugenic significance of such a situation as that depicted here depends on a more refined analysis of the trends than is possible with the data at hand. That the tendencies charted here foreshadow the future of America can hardly be questioned. Information might be obtained by modern research methods which would make possible rather definite assurances for the future, or the definite prediction of racial disaster in the event that present trends persist unchanged. Unfortunately, many of the facts on which such predictions must rest are not available, and are not being obtained. The data on which this chart is based are from Column (2) of Table III.

cludes that while the "center of manufactures" shifted westward more than the "center of population," and while there has been some tendency to decentralization of industry and to the establishment of "more nearly an equilibrium between population and wage jobs," it is "impossible to say whether these decentralizing tendencies are as strong as they have been generally described." In general, concludes Thompson:

> Industry remains quite highly concentrated in large urban centers. The dispersion which has occurred consists principally of expansion into areas adjoining the dominant population and industry centers, rather than into the thousands of smaller cities and towns throughout the country. The process also has taken the form of a relatively smaller growth of industry in the key cities of the 10 great industrial areas than in those large cities located elsewhere.[35]

D. B. Creamer finds both concentrating and diffusing tendencies but no marked decentralizing tendency. First, an analysis of the location of wage jobs reveals that while the proportion of wage jobs in the principal cities of industrial areas declined in all areas but New England in 1899-1929, only in the South Atlantic states did the proportion of wage jobs fail to decline in the group of sparsely settled counties. Yet even in this region industry diffused into counties of moderate industrial concentration. In the other seven industrial regions the "periphery areas" of industrial and urban centers gained, as did important industrial counties, at the combined expense of principal and satellite cities, other cities of over 100,000, and counties not industrially important. Moreover towns of 10,000-100,000 gained relatively most

until 1933 when the relative decline of towns under 10,000 ceased. In general then, in 1899-1933 there took place "a diffusion of wage jobs into the periphery or suburban areas and into the counties of moderate industrial concentration." Second, an analysis of 24 industries reveals: (a) that between 1929 and 1933 a slight tendency to relative dispersion may have developed in certain durable goods industries; and (b) that in the semi-durable goods industries a tendency to some diffusion manifested itself only in the clothing trades in which competition was intensified and the competitive advantages of low labor costs were relatively significant. Third, an analysis of the relocation of establishments and of wage jobs "indicates that the most pervasive locational forces have operated to diffuse manufactures among the 200 industrial counties rather than to scatter manufactures broadcast among the remaining 2,800 non-industrial counties."

Creamer concludes therefore that the possibility of industrial decentralization is very limited, a conclusion which suggests that future migratory trends will not differ essentially from those observed since 1900:

> Diffusion among the 200 has been the more persistent and stable locational tendency. It has been suggested that cheap and ubiquitous electric power might attract manufacturing to the countryside, but it is doubtful if power costs in most industries are large enough to be a determining factor. On the other hand it is probable that impending changes in our railroad system and a more complete adaptation to truck and highway transportation will result chiefly in the extension of the industrial periphery. It seems more reasonable to expect that the industrialized counties of the future may number 250 instead of 200 than to look for any wide dispersion of industry. The promotion of industrial and community activity in these peripheral areas, therefore, is fraught with fewer social problems. It avoids the potential dangers of creating "company towns" or a well-housed population stranded on a subsistence garden of an acre or two. These dangers, we suspect, are inherent in the efforts to scatter industry among the small towns remote from large cities.

Cyclical Tendencies in Internal Migration

In the previous section we reviewed the materials pertaining to the long-run trends in internal migration and (in Table I) indicated certain factors which influenced, or were associated with, internal migration trends in 1920-30. Goodrich in Study II presents more detailed evidence relative to whether or not migrants during the prosperous twenties tended to improve their economic lot and to whether or not they migrated to places "that were to prove unusually vulnerable in time of depression." What is even more important, his findings provide an answer to the question: Has the depression-caused migration during the post-1929 period "carried people to localities in which they could ride out the storm more easily, and has it or has it not left them in places in which their prospects for the future appear more favorable?"

For the purpose of arraying and comparing the level of economic life in counties of net emigration and net immigration three types of indices were used: (a) the average percentage of the population on public relief in the year beginning July 1, 1933; (b) gross farm income per rural-farm inhabitant in 1929; (c) a "plane of living" index based on the relative frequency of income tax returns, home telephones, and radios in the population of given counties as compared with their relative frequency in the population of the nation as a whole. States were classed according to: (a) entrance wage rates of common labor in 1929; (b) earnings in mines and quarries in 1929; (c) farm wage rates in 1929; (d) per capita income in 1929; and (e) and (f) retail sales per capita in 1929 and 1933 respectively. The indices for both the states and the counties tend to confirm one another and to give a rather uniform picture of the economic condition of given areas. There is "considerable agreement among the more favored states and a still greater consistency among the less fortunate.... On the whole the picture displayed lends substantial support to that derived from the study of tax returns, radios, and telephones." The data on

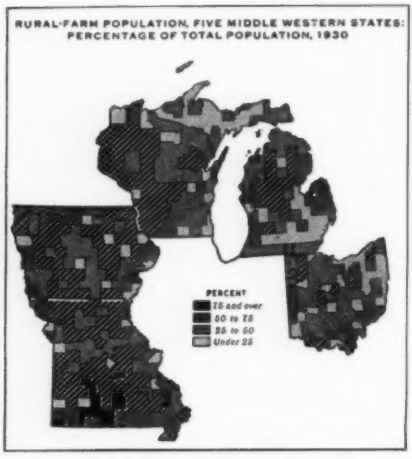
retail sales for 1933 suggest, moreover, "that the relationships among the states have not been very drastically altered even by the varying incidence of the great depression."

Wide variation in the economic lot of the population of different parts of the United States is revealed. The farm income figures "indicate the rural areas that fared worst in pre-depression days" and "provide useful clues for determining differences in living levels" in so far as these are determined by agricultural income. Moreover, the relative position of counties in farming areas as determined by these figures agrees roughly with their position as determined by the "plane-of-living" index. This index indicates roughly that "industrial, governmental, educational, and other cities and their environs, and favorite resorts, take most of the best places, with railroad centers, mining, and the best farming entering to a very small extent. Then come most mining counties, and mediocre farming; while the poorest sections are those where the land is either very poor, or overcrowded for its present largely agricultural use. . . . It is impossible to avoid an impression of tremendous regional and occupational inequalities."

Migration during the prosperous twenties tended on the balance to improve the economic condition of the migrants. Ten southeastern states, marked by relatively lower levels of living, gave up 1,700,000 people. Urban and industrial counties with relatively higher levels of living gained through immigration. For the country as a whole "the poorest subsistence-farming areas" lost relatively the largest number of emigrants; the regions of "more profitable agriculture" lost relatively the fewest. Of the 80 counties with relief percentages of 30 or more, 70 "were areas from which redundant population was being drained away during the twenties." In 1922-30 the poorest one-fourth of the middle-western agricultural counties lost about 2½ times as large a percentage of their population as did the wealthiest one-fourth. Among the exceptions to the rule that migration was from poor and less secure to wealthier and more secure areas Goodrich cites; (a) the Great Plains states where the agricultural counties, particularly the poorest areas, experienced increase in total population; (b) a number of industrial and mining counties with more than the average relief percentages which experienced more than average population growth in 1922-30; (c) a number of areas in which low relief percentages correlate with a population decrease or with no population change rather than with a population increase; (d) the counties with relief loads of 8-16% in 1933-34 into which immigrants came in 1922-29 from farming regions where the relief percentage has remained under 8.

Relief percentages vary widely. The "areas of extraordinarily high relief" are largely agricultural areas marked by "chronic rather than temporary conditions of distress," if one may trust the measures of relative prosperity described above; no "substantial cities and no manufacturing districts" are included. Relief percentages in the counties for which data are available (i.e. 90 per cent of the total) equal or exceed 16 per cent in 19 per cent of the manufacturing and/or urban counties, in 21 per cent of the agricultural counties, and in 50 per cent of the mining counties (primarily in counties where copper, coal, and iron ore are mined). Relief percentages in industrial counties are highest in general in those counties in which the production of durable and producers goods predominates.

While the migration of the twenties was in the main from worse to better areas, post-1929 migration, as revealed by changes in the school population, has been carrying the migrants to "population traps,"—to areas marked "either for 'permanent poverty' or for a drastic reduction of population." Data for five middle-western states indicate that "nearly three-fourths of the



DISTRIBUTION OF RURAL POPULATION

Figure 8

In these five agricultural states only a few counties in southern Missouri have more than three-fourths of the population on farms at the time of the last census. These counties are among those in the lowest income group (Figure 9). Figures 8 and 9 from Goodrich, Allin and Hayes.[5]

AGRICULTURAL COUNTIES OF FIVE MIDDLE WESTERN STATES CLASSIFIED INTO FOUR GROUPS ACCORDING TO GROSS FARM INCOME PER RURAL-FARM INHABITANT IN 1929
INCOME GROUPS*
Lowest
Second lowest
Next highest
Highest
ONE FOURTH OF AGRICULTURAL COUNTIES IN EACH COUNTY GROUP

RURAL INCOME COMPARED

Figure 9

The division of the counties according to gross income in 1929 roughly classifies them on a basis of land quality. The white areas show regions not predominantly agricultural. Migration prior to 1929 was away from the counties having a large rural population and low income. Post-depression migration has been toward these same rural problem areas. Thus pre-depression and post-depression population movements have been opposite in their economic effect on the migrants.

total increase from 1930 to 1933 in school population of agricultural counties occurred in counties classified as the poorest half in each state, and 40 per cent took place in those defined as the poorest quarter." Moreover, the very counties (i.e., the poorest quarter), which, in 1922-30 lost population at a rate 2.5 times that of the best quarter, in 1930-34 gained population at a rate 4.4 times that of the best counties. In Kentucky and West Virginia net immigration since 1929 and a high birth-rate have greatly increased the population of the poorest counties, augmented population pressure. Thus there has grown up, on "steep, eroded lands" a surplus population for which "coal mining will not afford a sufficient outlet." In Michigan the presence of unemployment-ridden Detroit has caused a relatively large migration to poor counties. The return of 1,350,000 persons to the farms of the South in 1930-34 has not only greatly aggravated population pressure and led to the substitution of a "cheap-wage system" for the hitherto paternalistic tenant system but has actually produced effects reminiscent of England's poor law system in the days of Malthus.[17]

Concerning the future of areas with high percentages of the population on relief Goodrich's finding indicate that, since the poorest one fourth of the counties of the United States consist largely of the very regions designated by the National Resources Board as areas in which farming should be discontinued in whole or in part, those who are on relief in these areas (or have migrated thereto), have no prospect of bettering their lots in these areas. Given recovery, however, those on relief in industrial counties and in most mining counties can be reabsorbed into industry and share in such prosperity as may develop. While Good-

rich admits the probable recent necessity of returning to poor-land areas he agrees with Creamer's observation that a widespread scatter of either population or industry will hardly conduce to welfare even though it may at times facilitate the provision of relief:

> Greater increase of population in poor-land areas than in good-land areas during the depression has both long-time and emergency implications for those concerned with problems of land planning and population redistribution. In the long run, attempts at permanent rehabilitation of back-to-the land migrants in poor-land areas are most likely to fail. Places to which people have moved in the largest numbers during the depression, or which the largest numbers have been attempting to leave but without success, are not the places where they either should or will stay with the return of prosperity. During the emergency, however, the use of land sub-marginal for commercial agriculture but available for subsistence-farming and "squatting," has served thousands of people as the best economic opportunity known to them. Though many who sought refuge in such areas might not have done so had they never lived there before, it seems clear that any program designed to prevent the use of poor land as a shock absorber for industrial unemployment will have to provide alternatives as good or better than those withdrawn.

Sources of American Population Growth

None of the studies of migration deals with the quality of the migrants, or with the effect of their migration upon the qualitative composition of either the areas of emigration or the areas of immigration. Moreover, while several studies of migration from farms in circumscribed areas suggest that sometimes the less competent and sometimes the intermediately competent farmers abandon the farms, we possess no extensive knowledge of the quality of emigrants from farms. If, however, we combine data on net reproduction in the United States with data on internal migration, it is apparent that emigration streams from areas in which net reproduction, particularly in the lower biologico-cultural groups, is relatively high. If so, the cultural level and perhaps the biologically-qualitative level of the population in areas of immigration is held below what it otherwise would have been.

Net reproduction varies widely from state to state (see column 2 in Table III) and from occupational class to occupational class. In 1928, Lorimer and Osborn[16] (p. 74) report, net reproduction rates per generation per occupational class were: unskilled labor, 1.17; agricultural, 1.32; semi-skilled labor, 1.03; skilled labor, 1.06; business and clerical classes, .85; professional classes, .76. Studies by the staff of the Milbank Fund, more recent studies by Stouffer and by Bossard, and data on the age composition of the population on relief, indicate that fertility is higher among those unemployed and/or on relief. Lorimer and Osborn conclude that present differences in the fertility of social groups will probably not "be levelled off or reversed in this country in the visible future, unless extensive public measures are undertaken to produce this result"[16] (pp. 95-96), and that:

> The only groups in the United States which are at present reproducing at rates far above actual replacement needs are located in certain rural areas, and prominantly in communities that are at the lowest economic levels and most remote from those educational and cultural influences which are held typical of social progress in this country. And within the towns and cities, the lower occupational groups, especially those in marginal economic circumstances, and dependent groups, characterized by low ratings as regards cultural-intellectual development, are commonly found to have birth rates somewhat above replacement needs and far above the birth rates characteristic of neighboring groups with superior advantages. At the same time there is hardly a single urban group in which the majority of the young people enjoy the advantages of high school education and in which many continue their education through college that is now replacing itself from one generation to another. (p. 199.)

Whether and to what extent the culturally adverse trends in net reproduction are also biologically dysgenic is not readily measurable. The evidence suggests, however, that: (a) cultural and biological submarginalism is relatively more frequent in the unemployed than in the employed classes; (b) that

our social system has tended to select the relatively better endowed and shift them into the upper occupational and income classes. If so, reproductive selection is biologically dysgenic. Whether or not internal migration is aggravating dysgenic cultural and biological selection in areas of net immigration depends upon whether or not the composition of the immigrant stream differs from that of the resident population. The data in Tables I-III suggest that the composition of the immigrant stream is culturally below that of the resident population. This stream may also set loose dysgenic influences in the differential increase of the resident population. Lorimer and Osborn,[16] in a cautious summary, suggest that in agricultural communities in the East migration may have left a residue of handicapped families and that the lowest social groups in urban centers "are significantly below the large middle classes in *average* hereditary capacity for intellectual development." They find no evidence for or against the proposition that migration has a biologically dysgenic affect upon the population of areas of immigration.

Further evidence, corroborative of the findings of Lorimer and Osborn, is supplied in Table II. The main conclusions follow:

(1) Net reproduction per generation* in the native white population is not influenced by the rate of increase in the total population (column 3).

(2) While net reproduction is relatively higher in states where the proportion of negroes in the population is higher (column 15), it is relatively lower in states where the number of foreign born is high relatively to the white population (column 16).†

(3) Net reproduction is relatively low in states where the percentage of increase in the negro population is high (column 14), presumably because (see conclusion 8) the factors which attract and hence foster the increase of the negro population are not conducive to fertility.

(4) Net reproduction is relatively high in states from which native whites emigrate, low in states into which native whites immigrate (column 4).

(5) Net reproduction is low in states where economic income and status are high and high in states where economic income and status are low (columns 6-7).

(6) Net reproduction may be slightly higher and lower respectively in states in which insecurity, as measured by the percentage of the population on relief, is higher or lower (column 8).

(7) Net reproduction is greatest in states low in cultural rank, lowest in states high in cultural rank (columns 9 and 10).

(8) Net reproduction is low in states in which industry and non-agricultural pursuits predominate, high in states in which agriculture and non-industrial pursuits dominate (columns 11-13).

Summarizing, the evidence suggests: (a) that an unduly large proportion of natural increase comes from groups less equipped culturally and to some extent from groups ranking low in natural endowment; and (b) that internal migration carries a culturally less equipped population to the areas of immigration. The evidence does not permit or suggest a conclusion relative to the direct effect of migration upon the biological composition of the population of areas of immigration.

Indications for Social Policy

The evidence presented in the preceding pages suggests certain policies to be incorporated into a national demagraphic program. First, such land areas as Goodrich and Creamer, the

*Net reproduction per generation per state correlates highly with both the average numbers of children ever born per mother per lifetime in the various states and with the number of children under 5 per married woman, aged 15-44 years. The 22 states (New Hampshire, Texas, South Dakota, and Massachusetts are not included) with the highest net reproduction rates include 18 of the 22 states highest and but 4 of the 22 states lowest in either average number of children ever born or children under 5 per married woman, aged 15-44; the 22 lowest in net reproduction include 4 of the 22 highest and 18 of the 22 lowest in the other two categories.

†J. M. Gillette[4] found that low native white fertility was associated with the presence of white foreign born, but not with the presence of negroes. Gillette suggests that since the negro is not free to enter every occupation (i. e., occupies a position of social status), his presence does not intensify economic competition and thus intensify the desire to limit family size as does the presence of foreign born.

National Resources Board, and state planning bodies have found to be unsuited to certain uses or to any use should be employed only in suitable uses (e.g., forestry, recreation, etc.) or withdrawn from use completely. Both the national and certain state governments are already effecting such a policy.*

Second, provision by state and federal governments of supplementary funds for the operation of schools, local government, etc., should be so conditioned as not to attract population to or hold it within areas unsuitable to a relatively high level of economic existence. Third, to prevent the flow of unemployed persons into "population traps," a national corporation should be established to employ unemployed elements of production in times of stress. Given such a plan† unemployed workers will have an alternative preferable to retreat to poor-land areas. Moreover, the creation of an economically helpless unemployed industrial reserve army, and the consequent depression of wage levels, temporary but uneconomic relocations of industry, and impulses to future relatively unrestrained economic booms‡ will be avoided. Fourth, both the unemployment reserve provided under the new social security act and any funds used to construct public works in time of depression, must be administered in a manner designed to keep the population out of areas unsuited to economic use.§ Fifth, assuming that the federal government continues to exercise control over agriculture, it is preferable that the less fit be encouraged to move from agricultural to non-agricultural areas. Such a policy will foster eugenic selection inasmuch as rural life is more conductive to natural increase than life in non-agricultural areas. Sixth, since migrants move from areas (e.g., in the South) where educational opportunities are relatively limited, both the wholesomeness and the economic efficiency of the population of the nation would be appreciably elevated by Federal subsidies to schools in relatively backward states with the proviso, however, that the school curriculum be determined by the federal government and that procreation by the relatively unfit be in no way encouraged. Seventh, any effort to equalize per capita incomes as of different regions or of different occupations can succeed only in proportion as net migration from relatively congested areas and occupations, plus a reduction of differentials in net reproduction, serve to equalize rates of population growth in areas and occupations relative to the demand for their respective products. Eighth, if eugenic selection is to be fostered, present governmental programs which primarily aid the relatively less fit must give way to a program of aid to the relatively fit (as determined by satisfactory tests and other measurements) among whom the capitalistic industrial system (as it currently functions) makes infertility virtually imperative. No eugenic program can succeed so long as methods of conception control are not effectively diffused among the relatively unfit.

Ninth, the relative importance of in-

*See for example the method of zoning property for rural use in Wisconsin[18] and the program outlined for Minnesota.[11]

†Such a plan has been outlined by F. D. Graham.[8] This plan, adapted to a capitalistic economy, would necessarily be modified in a socialistic economy.

‡The persistent presence in rural areas of a surplus population which agriculture cannot absorb—a surplus traceable to relatively high rural natural increase and to the tendency of unemployed to migrate to rural areas in times of depression—checks the rise of real wage levels in good times and thus conduces to a maldistribution of economic income which in turn conduces to business recession and unemployment. This theory, first developed by G. Cassel, has been confirmed so far as Sweden is concerned by G. Myrdal.[10]

§English experience shows that the concentration of susidized relief works in areas which are likely to remain permanently depressed prevents the very evacuation of population which is necessary.[10]

ternal migration coupled with our lack of knowledge of the qualitative composition of the migratory stream or of the population of areas of emigration renders it urgently necessary that the relevant data be accumulated.

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◆

Books Received

BOOKS are acknowledged in this column as received, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. As far as space permits, books that contain material of special interest to the readers of the JOURNAL *will be reviewed in later numbers.*

LE PANSOMA ET LA GEOMETRIE DE L'ENERGIE, *by* Dr. A. C. Leemann. Pp. 257. Price, Francs suisses 15. Georg & Co., Geneve, 1935.

DIE ORGANISCHEN UND FUNKTIONELLEN ERBKRANKHEITEN DES NERVENSYSTEMS, *by* Priv.-Doz. Dr. Friedbrich Curtis. Pp. 195. Price, 14.80 RM. Ferdinand Enke Stuttgart, 1935.

GENETIC VARIATIONS IN RELATION TO EVOLUTION—A Critical Inquiry into the Observed Types of Inherited Variation, in Relation to Evolutionary Change, *by H. S. Jennings.* Pp. 139. Price, $2.00. Princeton University Press, Princeton, 1935.

RACE, SEX AND ENVIRONMENT—A Study of Mineral Deficiency in Human Evolution, *by* J. R. de la H. Maret, B.Sc. Dipl. Dist. Anthrop. Pp. 342. Price 21/. Hutchinson's, London, 1935.

THE SPECIES OF TRADESCANTIA INDIGENOUS TO THE UNITED STATES, *by* Edgar Anderson and Robert E Woodson. Pp. 132. 12 Plates. Price, $2.25. Arnold Arboretum of Harvard University, Jamaica Plain, Mass., 1935.

VARIATIONS UND ERBLICHKEITS STATISTIK, *by* Dr. phil. Erna Weber. Pp. 255. Price, RMK. 7.20. J. F. Lehmanns Verlag, Munchen, 1935.

THE ESTABLISHMENT OF THE "A" STRAIN OF INBRED MICE

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IN THE summer of 1921 I obtained two albino mice while working at the Carnegie Institution of Washington, Department of Genetics, Cold Spring Harbor, Long Island. One of these (*A*) came from the stock that Dr. Little had been continuing at that institution. The exact origin of this mouse is uncertain. The other one (*B*) was from the colony that Dr. Bagg had brought to Cold Spring Harbor from the Memorial Hospital, New York City. This colony had been continued since 1913 by Dr. Bagg mainly by pen matings, although some degree of brother-sister matings had been used. He had originally obtained the stock from a dealer in Ohio. These two mice were mated together in July, 1921. Among the progeny obtained two, *1A* and *2A*, were mated together in August of the same year. On the fifteenth of October of 1921, the above mating gave three progeny (*1*, a female, *2*, a female, and *3*, a male). Female *2* was mated to her brother *3* and on the twenty-fourth of January, 1922, gave birth to a litter of six young (three females *9*, *10*, and *13*; and three males *11*, *12*, and *14*). See Figure 10.

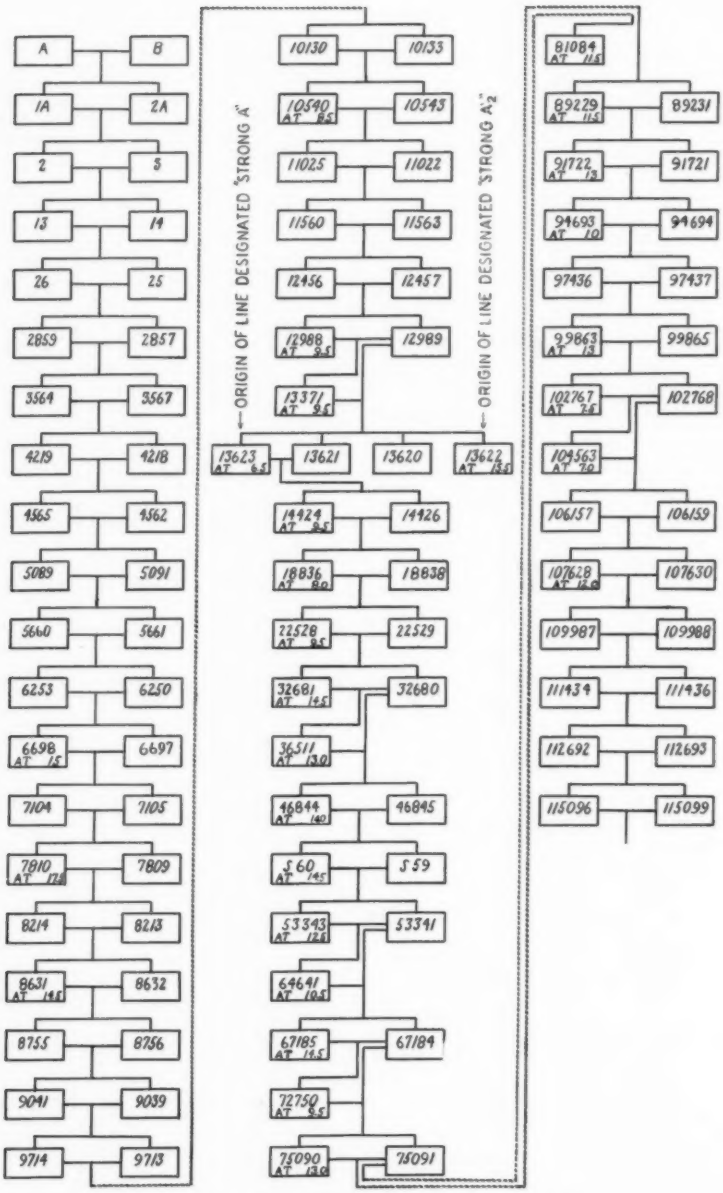
Since that time the stock has been continued primarily by brother-to-sister matings as shown according to Figure 10. In the producing of the fifty-five inbred generations obtained up to date there has been a deviation from this brother-to-sister mating only six times. These were when females *13371*, *36511*, *64641*, *72750*, *81084*, and *104563* were mated back to their own fathers respectively. These deviations from the accepted brother-to-sister mating were necessitated by the fact that brothers were not available for breeding purposes when desired.

Spontaneous Tumors

Up to the summer of 1927 all mice produced in this line were used for transplantation studies on the tumors *dBrA*, *dBrB*, *dBrC*, *dBrD*, and their mutant forms. Consequently observations on the incidence of spontaneous tumors in this inbred strain of mice were not done except in a few sporadic cases such as in mice *6698*, *7810*, and *8631*, where spontaneous tumors of the mammary gland occurred at 15, 17.5, and 14.5 months respectively. But in 1927 several different albino mice developed spontaneous carcinoma. The occurrence of spontaneous carcinoma of the female mammary gland was so frequent then that further studies of transplantation were discontinued, in order to concentrate on the study of primary tumors.

During the year 1928, two sisters, *13622* and *13623*, developed spontaneous carcinoma near the opposite extremes of age distribution for such tumors. Mouse *13623* developed a tumor on the right side of the vagina (right fifth nipple system) on the twenty-sixth of March, 1928, at 6½ months of age; *13622* developed a tumor in the left shoulder region (left second nipple system) on the 11th of December of the same year. She was then 15½ months old.

*Acknowledgment is made to the Josiah Macy, Jr. Foundation and to the International Cancer Research Foundation for grants, by which the genetic stock mentioned in this paper has been continued for experimental purposes.



ANCESTRY OF TUMOR-BEARING STRAIN

Figure 10

This chart shows the lineal descent of a single pair of mice obtained in 1921. In nearly every case the mating has been by a brother to his own sister. The direct female line is on the left, the male line on the right except in case of mice No. 13623, 13621, 13620, and 13622, where the mice on the left and right are females, whereas the two intermediately placed animals are males. The age at which spontaneous carcinoma of the mammary gland occurred is stated below the serial number of the females. In case the space below the number of the mouse is blank, the mouse in question died of some other cause of death than cancer, except in the last few generations on the chart where the animals are too young to have developed cancer. The collateral lines containing thousands of mice together with several hundred cases of spontaneous cancer are not included in this chart.

A selection experiment was set up. The descendents of mouse *13623* were selected toward the early incidence of spontaneous carcinoma of the mammary gland. In the other line descended from *13622* selection was made away from cancer. For this purpose the descendents of that mouse only which lived longest without developing cancer, or which developed cancer last, were continued in each generation. The negative effect of this selection was reported in the JOURNAL OF HEREDITY.[27] The descendents of mouse *13623* received the symbol *A*; the descendents of mouse *13622* received the symbol A_2.

At the present time the 55th generation of inbreeding has been reached. Beginning with mouse *12988* every female in direct line for nineteen generations has developed spontaneous carcinoma of the mammary gland. For the last four generations the females in direct descent are still living, most of them too young for spontaneous tumors to appear.

Genetic principles of inbreeding demonstrate that these mice now being continued by a brother-to-sister mating have reached a high degree of genetic homogeneity. The non-effect of selection toward and away from spontaneous carcinoma of the mammary gland is positive evidence of this expected homozygosity.

It is certain then that the biological or genetic factors which unquestionably underly the incidence of spontaneous cancer in mice have been standardized.

The "A" Strain in Cancer Research

Representatives of this inbred strain have been used extensively for many projects in cancer research. My own original personal interest was centered around the study of transplantation of tumors, using the *A* strain as the negative parent.[13-26, 31] In addition to this, however, the strain was used by Bittner[3] and Cloudman[4] at the University of Michigan. Representatives were left at the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, and have been sent to several other laboratories in this country and in Europe. During the past two years the strain has served for many cooperative projects at Yale University, including (1) studies on tissue culture in collaboration with M. R. Lewis of Johns Hopkins University,[10, 11, 12] (2) oestrous cycle relationships with the growth of spontaneous carcinoma of the mammary gland and ovarian and pituitary grafts with Allen, Gardner, Diddle, and Burford,[1, 2] (3) the study of the postpartum development and involution series of the mammary gland in collaboration with Gardner,[6, 7] (4) the induction of male mammary gland rudiment carcinoma with folliculin benzoate in cooperation with Gardner and Smith,[8, 9] and (5) studies on the effect of the essential oils on the incidence and severity of spontaneous carcinoma in mice.[28, 29, 30]

For the following reasons I propose that mice belonging to these two strains of mice be designated as the Strong *A* and the Strong A_2 inbred mice: (1) the hybrid origin during the summer of 1921 ought to set them apart from one of their ancestral parents (the Bagg albino); (2) a distinct type of brother-to-sister mating was at that time put into effect. Thus, because of origin and peculiar type of mating, the separation of this stock as an entity has received the sanction of Dr. Bagg of the Memorial Hospital, New York City.

Conclusions

1. The lineal descendents of mouse *13623* constitute line *A*.

2. The lineal descendents of mouse *13622* constitute line A_2.

3. In these two strains the biological or genetic factors underlying the development of spontaneous carcinoma of the female mammary gland have been standardized; biological variability has consequently been reduced to a minimum.

4. The *A* and A_2 mice are therefore

suitable not only for the study of spontaneous tumors, but also for innumerable projects where proper control animals are in demand.

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INHERITED CHARACTERS IN THE TOMATO

II—Jointless Pedicel

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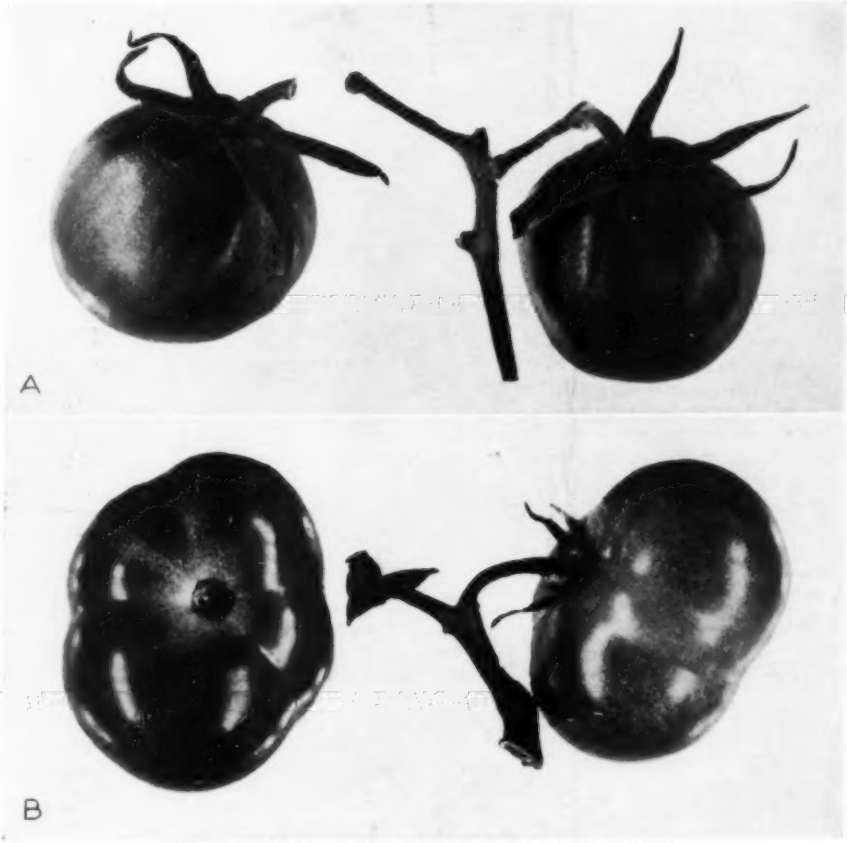

NORMAL AND JOINTLESS PEDICEL TOMATOES
Figure 11

The normal tomato inflorescence is shown at *A* with one fruit detached in the ordinary way at the abscission joint, leaving the calyx and part of the pedicel attached to the fruit. A "jointless" inflorescence is illustrated at *B* which shows the curved jointless pedicels and the detached fruit with the calyx still remaining on the fruit stalk. This is due to the absence of the normal abscission joint of the pedicel in "jointless" plants.

WHILST picking the fruits of certain tomato crosses it was noticed that when the fruits of some individuals were picked the calyxes always remained on the plant instead of coming off with the fruit as they usually do. More critical examination showed that these plants lacked

the characteristic abscission joint which occurs on the geniculate pedicel at a point midway between the peduncle and the calyx in the common tomato varieties (Figure 11). Study of the pedigree of these plants showed that jointless pedicel was a simple recessive which came from the French variety Rouge naine hative, and subsequent breeding behavior indicated that this character was closely linked with leafy-inflorescence in the fifth chromosome.

Description of the New Character

Jointed pedicel J vs. *jointless pedicel j*

The pedicels of all the common tomato varieties are geniculate and have a swollen abscission joint at a point midway between the peduncle and the calyx. This abscission joint usually forms the place of detachment when the fruit is picked, thus leaving the calyx and half the pedicel attached to the fruit. In the variety Rouge naine hative, however, the pedicels are curved instead of geniculate, and they lack the characteristic abscission joint of the other varieties. When the fruits of this variety are picked the calyx remains attached to the plant, a corky abscission layer being formed between the receptacle and the epidermis of the fruit. This character is quite noticeable in cases where fertilization does not take place, as under such conditions the calyx and half the pedicel falls off the inflorescence of the normal jointed kinds, whereas in the jointless kinds the corolla and essential organs shrivel up leaving the normal calyx still attached to the plant.

Linkage Relations

There are three other characters in the fifth chromosome, but until a four-point backcross is made it is impossible to give the exact relationship of *j* to these. The following table shows that *j* is very close to leafy-inflorescence, but the F_2 and backcross results are inconsistent for the other genes.

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Linkage Data of *J* with Fifth Chromosome Genes

Generation	Leafy-inflorescence	Fasciated fruit	Green stem
Backcross	1.07 ± 0.5	31.0 ± 2.3	32.7 ± 2.3
F_2	1.5 ± 0.2	40.1 ± 1.4	40.0 ± 3.1

✦

Errors in German Sterilization Totals

A CORRESPONDENT has called attention to discrepancies in the note on German Sterilization in the December issue (Vol. 26, p. 487, right hand column). The figures given by Massfeller are as follows (corrected figures in italics):

Number of sterilization actions entered:	
Men	42,903
Women	*41,622*
Total	*84,525*
Cases disposed of:	
Sterilizations ordered	56,244
Sterilizations refused	3,692
Withdrawn, transferred, etc.	4,563
Pending, end of year	*20,026*
Total	84,525

These errors do not significantly alter the picture of what actually took place in the first year of the German Sterilization Law, but the editor is mortified that as originally published the figures are a public demonstration of his congenital inability to add and to subtract. The discrepancy in the figures on appeals appears to be due to an item of 309 cases which were disposed of in process of litigation (transferred, etc.). Massfeller gives no information on this point.

R. C.

CAMPTODACTYLISM AND ITS VARIABLE EXPRESSION

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It is questionable that the hereditary factor responsible for the condition known as camptodactylism produces any deleterious effect upon its recipient other than the impairment of the manipulation of the hands. The factor is expressed in the little finger and usually also in the ring finger. These fingers are, as reported by Goldflam,[3] fixed in a position of flexion such that difficulties result in the opening of the hand and the grasping of objects. In one family studied by Goldflam, twenty-six persons in three generations were affected. As Goldflam found it, camptodactylism is comparatively rare, is regularly dominant, and may be expressed in either or both hands of the individuals so unfortunate as to inherit the factor responsible for the abnormality.

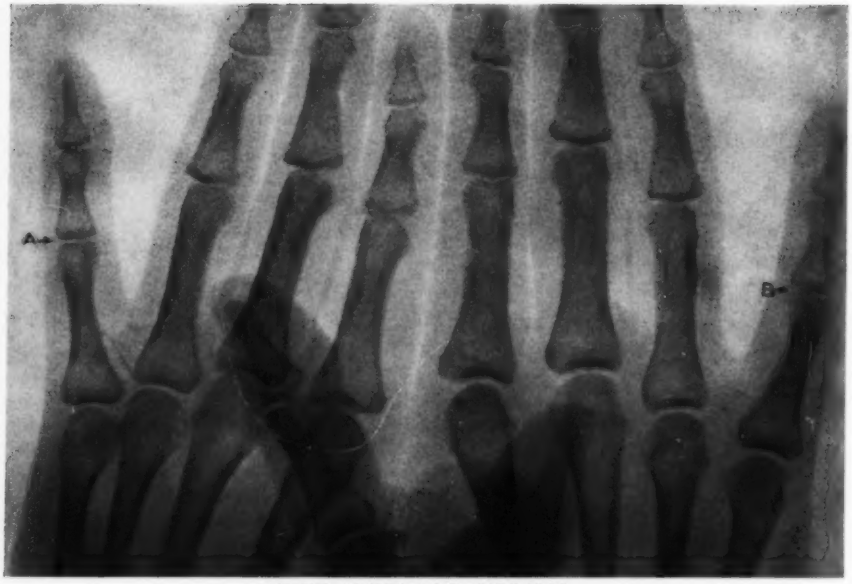
An example of human inheritance which probably deserves rank with camptodactylism came recently to the attention of the authors. Data were available regarding only four generations. Seventeen individuals were produced in the four generations and eight exhibited a malformation of the little finger of either the right or left hand, or both. The phenotypic expression of this factor does not parallel that of the camptodactylism studied by Goldflam, in that in no instance is the ring finger affected. Hence it is probable that the factor responsible for the malformation of the hands here described is not the same as that reported by Goldflam. If the factors of the two cases are at the same locus, the one herein reported must be accompanied by modifiers which, of course, are beyond our powers of detection, or it may possibly be a weak allel of Goldflam's camptodactyl factor.

The genealogical arrangement of Figure 13 shows the character to have been introduced into the family by a female. The second generation was composed of a son and two daughters, one of the daughters having the little finger of the left hand fixed in a position of flexion such that the proximal interphalangeal joint was involved. The third generation, children of the abnormal daughter, comprised two sons and one daughter. One of the sons expressed the character in the second joint of the little finger of the left hand. Marriage of this abnormal individual resulted in the birth of one son and two daughters. Both little fingers of the boy were fixed in flexion. Of the girls, the little finger of the left hand of the one was flexed, while in the case of the other the proximal interphalangeal joint of the fifth digit of one hand was much larger than that of the other hand. The other son of the third generation appears normal, and of seven children begotten by him, the five boys are normal, but the two girls exhibit an abnormality of the proximal interphalangeal joint of one fifth finger. Of these one is affected on the left, the other on the right hand.

The fingers of these girls are not fixed in flexion as is true of the corresponding digits of their ancestors and cousins. In their case, the proximal interphalangeal joint of the finger is stiff, keeping the digit in a position of constant extension.

Referring to Figure 13, it is obvious that the factor for this particular form

Note: We wish to express thanks to Professor F. J. L. Blasingame, of the Medical Branch of The University of Texas, for his many helpful suggestions in dealing with this case of human inheritance.



STIFF JOINT AND NORMAL

Figure 12

An X-ray photograph of the hands of IV-6, in the chart (Figure 13). *A* shows the stiff joint on the left hand; *B*, the corresponding normal joint on the right hand. This photograph shows that the joint is normally formed, and that the bending of the finger is due to defects in attachment of some of the muscles controlling this joint.

of camptodactylism follows a dominant mode of inheritance. It may be further observed that the character may skip a generation as was true in the case of individual III-2. Goldflam was unable to establish the existence of normal "carriers." This individual appeared perfectly normal but transmitted the genetic factor for camptodactylism to two of seven offspring. In this connection, the genetic factor reacts similarly to the gene responsible for the condition known as symphalangism. According to the genealogical trees published by Walker[3] and Morgenstern,[4] this character occasionally skips a generation.

Nothing can be said of the linkage of the gene involved in the production of the malformation, save that it is not linked with the X-chromosome. If the factor had been linked with the X-chromosome, it would not have been transmitted from father to son, and individual IV-9 would have been normal. Since he was affected, but received his X-chromosome from his mother, who could not have carried the genetic factor, the gene must have been transmitted on an autosome from the male parent.

In consideration of the action of the gene in producing the condition of flexion, or the impossibility of flexion, it seems that irregularities of embryological development of the appendicular skeleton may be eliminated. The appendicular skeleton takes its origin from the embryonic connective tissue, passing through three distinct stages,—the blastemal, the cartilaginous, and the final osseous. The phalanges are first formed in cartilage which undergoes subsequent ossification to form bone. The cartilaginous phalanges are separated by embryonic connective tissue

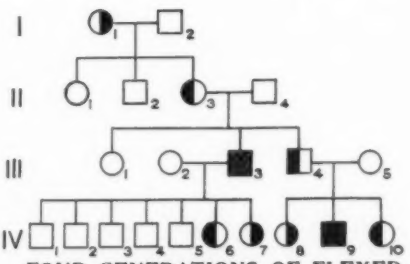


Figure 13

Half-blacked symbols indicate that the little finger of only one hand is affected. The shaded symbol indicates a normal appearing "carrier." The fact that most camptodactylic individuals are affected in only one hand suggests that the expression of the character is strongly influenced by environmental factors.

destined to form, by liquifaction and differentiation, the joint cavity and the articular membranes. In the process of liquifaction and differentiation, the synovial membrane and synovial fluid develop (Bailey and Miller[1]). An inhibition of liquifaction during embryonic development would result in the failure of the formation of the joint cavity, the synovial membrane and the synovial fluid, permitting the possibility of complete ossification of the structures of the joint such that the proximal and middle phalanges might become one continuous bone. If ossification were not complete, the proximal phalanx would be separated from the middle phalanx by a single cartilage, the joint cavity and articular membranes being absent. In either of these hypothetical cases, the anomaly would be skeletal in nature and the finger would be completely immovable at the locus of the proximal interphalangeal articulation.

Such is not the case. The X-ray photograph (Figure 12) of the left hand of IV-6 reveals the presence of cartilage, and the proximal and middle phalanges represent two distinct bones rather than one continuous bone. The joint separating the proximal from the middle phalanx of the fifth finger appears, from the photograph, to be perfectly normal. Furthermore, there is articulation in this joint. Movement is very slight, but appreciable to the sense of touch. In view of the foregoing, it seems logical to conclude that the action of the gene is not one which affects the skeletal structure of the joint.

A superficial clinical examination of IV-6 offers an hypothesis which explains the conditions perfectly. From this it appears that the defect is in the attachment of the extensor expansion of the little finger. Normally, the expansion trifurcates into a central, stronger portion which becomes inserted into the dorsum of the proximal end of the middle phalanx, and two collateral, weaker portions which, after uniting with each other, insert into the dorsum of the proximal end of the distal phalanx. If we suppose that the collateral portions are longer, and perhaps also weaker, than normal, we should suspect such a defect as here found. Under such circumstances, more pull than normal would be exerted on the dorsum of the proximal end of the middle phalanx, with the tendency to keep it extended against the force exerted by the flexor digitorum sublimis and flexor digitorum profundus. The longer-than-normal collateral portions of the extensor expansion, while having the ability to extend the distal interphalangeal joint, would then be more easily overcome than normally by the flexor digitorum profundus, resulting in flexion of the distal interphalangeal joint to a marked degree. The conditions of this hypothesis are accurately fulfilled by the case.

Other members of the family who exhibit flexion of the proximal interphalangeal joints of the little fingers may have even more exaggerated defects, either in both parts of the extensor expansion, or in the muscles acting on it. In these cases it is likely that the lumbrical muscle is also affected.

The state of flexion observed in this case is similar to that of Dupuytren's contracture, mentioned by Baur, Fischer and Lenz.[2] It is improbable, however, that the flexion of our case could be caused by the same factor, since the

individuals under discussion exhibit the anomaly at birth, while Dupuytren's contracture appears after adulthood is attained.

Summarizing, the gene herein reported is an autosomal dominant that may occasionally skip a generation with respect to its expression. In so far as it has been studied, it produces no deleterious effect upon the individual, when in the heterozygous condition, other than a slight inconvenience in using the hand. It is impossible to predict what the result might be should the factor become homozygous. The effect of the gene is probably that of impairing the extensor expansion and other tendons associated with the movement of the phalanges of the fifth digit, or of the muscles that act upon these tendons.

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COPPER SULPHATE FOR MOUSE DYSENTERY

THE work of mouse geneticists is sometimes hampered by mouse diseases. During the fall term of 1934 the experimental stocks used by the elementary Genetics class at the Michigan State College suffered many mortalities from a dysentery attacking young nursing mice 9 to 18 days old. Individuals more than 21 days of age were apparently not affected though they could be carriers of the causative organism. Afflicted animals had a copious diarrhea accompanied by a hardening of the feces which sometimes closed the anal opening. The region of the anus became scabby and swollen, and there might be formation of pus. The death rate among afflicted animals was very high.

According to the Department of Bacteriology a streptococcus was responsible for the disease. A .25 per cent acqueous solution of copper sulphate was placed in the drinking bottles of the affected cages, and all other sources of water supply were withdrawn, compelling the animals to imbibe the copper solution. It was found that if infected adult mice were thus treated for 36 hours twice a week for a period of three weeks, the progeny of such animals born after treatment developed few or no cases of dysentery. The cages should be cleaned and disinfected frequently during the period of treatment. Pregnant females should be treated but once a week. The animals did not like such drinking water and appeared to avoid it, so in warm weather when a larger in-take of water was desirable a .15 per cent solution copper sulphate was used.

That the treatment is effective is indicated by the following experience. Six cages were extremely badly infected with the disease. There were 35 adult breeding animals in these cages, and out of 60 young 52 developed the characteristic symptoms and either died or were discarded. After 35 adults had been subjected to three weeks of the above treatment only three out of 74 young mice born subsequent to the treatment showed signs of the disease. After a period of six weeks the dysentery had not reappeared in subsequent litters. The treatment does not cure the young animals but it seems to eliminate the causative organism from the adult carriers.

Whether the copper sulphate treatment would work with dysentery organisms in other mouse stocks, we do not know. It is interesting to note that copper sulphate is used in the elimination of algae from water supplies. It is said that Chinese coolies suffering from cholera sometimes derive benefit from sucking copper coins.

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ARTIFICIAL INSEMINATION IN FOWLS

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ARTIFICIAL insemination, first tried by Spallanzani[8] in 1784 on the dog, was rarely practiced until the beginning of the twentieth century. At that time the development of methods of artificial insemination for domestic animals was begun and a few experiments were made with fowls. Early investigations with fowls, however, failed to develop a technic which gave satisfactory results in fertility and, in later experiments, poor fertility continued to be a decided handicap. Believing that previous failures to obtain reasonable fertility were due to the inadequate technics employed, the authors have developed a new method for artificial insemination of the fowl which may be used for various purposes.

Artificial insemination is not only useful in experimental procedures but may also prove valuable from a practical standpoint. It may be used to effect interspecies crosses or crosses within the species between breeds differing widely in body size. It may also be valuable in studies concerned with the physiology of reproduction. In a practical way it may serve to increase the value of progeny-tested males by extending their usefulness. Another practical use may be found in fertilizing eggs produced by hens kept in batteries in commercial poultry plants.

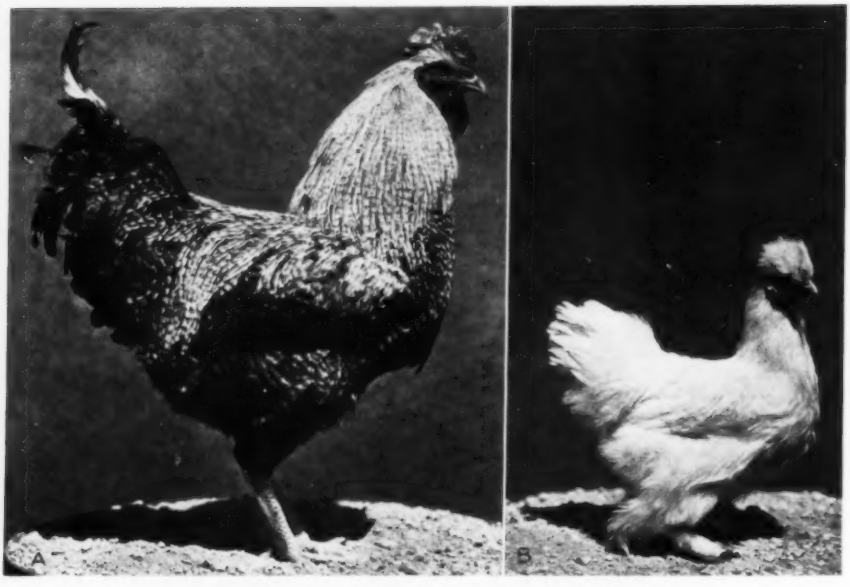
Ivanov,[3] using the semen of the cock, inseminated hens which had been isolated from the male for about three weeks. From these hens 43 eggs were incubated, 10 of which proved fertile. Later, 77 hens were inseminated and from "the large number" of eggs produced by these hens only 13 fertile eggs were obtained. From 12 of the fertile eggs incubated by Ivanov, two chicks were hatched. In the same year 16 hens were fertilized four times with semen from the Caucasian pheasant but no fertile eggs were obtained from this cross.

Payne[7] artificially inseminated hens known to be laying infertile eggs with the fluid obtained from the cloacae of hens which had been previously mated to a cock. He states that a "fair per cent of the eggs were fertile." The eggs were incubated and chicks hatched from them but no record of the number of fertile eggs or the number of chicks hatched is given. The method by which the artificial insemination was effected is not described.

Ivanov[4] refers to experimental procedures involving natural and artificial fertilization but gives no details as to the methods employed in the latter case. Dunn[2] made some experiments in artificial insemination using mixed semen. He states that "such difficulties were encountered in getting sperm from the two males at the same time and in effecting artificial insemination with regular success that it was finally given up."

Jull and Quinn[5] practiced artificial insemination in making reciprocal crosses between Barred Plymouth Rocks and Black Rose Comb Bantams. They obtained the semen in the manner described by Payne[7] and the insemination technic was similar to the one given by Ivanov[3] wherein the spermatozoa was placed on the exterior orifice of the oviduct. Artificial matings were made five times a week for two-month periods in 1928 and 1929. In both seasons a total of 969 eggs were incubated of which 19.1 per cent were fertile. About 50 per cent of the fertile eggs hatched.

Nikitina[6] developed an effective technic for artificial insemination of fowls. Preliminary experiments gave an average fertility of 55 per cent and chicks were hatched from 60 per cent of these fertile eggs. Later he states: "Eggs laid the first day after injection of the sperm were infertile; on the second day 50 per cent of those laid were fertile;



EXTREMES OF SIZE IN POULTRY MATING

Figure 14

The crossbred Rhode Island Red × Plymouth Rock rooster (*A*) weighs 3,610 grams. The White Silky bantam female weighs 912 grams. These size differences represent the limits in the experiment herewith reported. Natural matings between birds of this size show an extremely low fertility, but normal fertility is obtained by artificial insemination. Where extremes of size are involved this method saves much time and increases the accuracy of the results through making possible the obtaining of larger progenies.

on the third to seventh day 60 per cent were fertile; on the eighth to the eleventh day all eggs were fertile." No difference was noted between the results obtained by injecting the semen in large or in small quantities. It is believed by the authors that the effectiveness of Nikitina's technic was due to the exposure of the orifice of the oviduct with a nasal speculum.

Warren and Scott[9] employed artificial insemination in attempting to produce turkey-chicken hybrids, and reported fertilization of both turkey and chicken eggs with semen of the other.

The Technic of Insemination

The authors have recently developed a new method for obtaining semen from the cock, which has been described in considerable detail in an earlier paper.[1] By this new method it has been possible to obtain an adequate supply of semen from the crossbred males used in this study. During three of the four months of the experimental period these males have been confined to cages in fattening batteries.

The technic of artificial insemination consists in a method of exposing the oviduct and the direct injection of the semen into the uterus. In order to expose the oviduct the hen is held with the left hand under the breast and the index finger between the legs. She is then placed in a head-downward position with her back against the operator. While the hen is held firmly against the operator's body the left thumb and fingers are used to exert pressure on the lower abdomen. This pressure causes a slight protrusion of the vent. Sup-

plementary pressure is now applied to the rear of the abdomen with the thumb and forefinger of the right hand. This is done by placing the right hand so that the thumb and forefinger form an arch directly above the vent. The combined pressure on the lower portion of the abdomen and the rear of the abdomen will enable the operator to expose successfully both the orifice of the oviduct and the anal opening.

After some practice it will be found easy to exert more pressure with the forefinger of the right hand than with the thumb. The pressure of the forefinger should be from that part of the finger near the knuckle and not from the finger tip. This additional pressure of the forefinger will cause the oviduct alone to become everted, leaving the anal opening concealed in the cloaca. The operator may readily acquire sufficient skill to expose the oviduct very quickly and the injection of semen requires but a few additional seconds.

After the orifice of the oviduct is exposed, a tuberculin syringe (without the needle attached) containing semen is inserted, while the oviduct is held firmly in place by a steady pressure of the hands. Then, with the syringe firmly placed in the exposed oviduct, the pressure on the abdomen is slowly relaxed and the syringe is allowed to enter the oviduct as far as it travels easily, usually a distance of two to three centimeters. Then the semen is discharged from the syringe into the oviduct. If the injection of the semen is carefully done there will be no visible evidence of the fluid at the orifice of the cloaca when the syringe is slowly withdrawn.

Artificial and Natural Matings

Three virgin crossbred F_1 females (R. I. Red ♂ × Silky-♀) were artificially inseminated with the newly developed technic. During the next six weeks these pullets produced a total of 74 eggs, only two of which were infertile. Inseminations of these crossbred females were made at about 2 P. M., on five days each week, Monday to Friday inclusive, for a six-week period. Undiluted semen was used, the injections being made within a few minutes after the semen was obtained from F_1 males (R. I. R. ♂ × B. R. ♀). The quantity of semen injected at each insemination was approximately 0.2 c.c. This amount was arbitrarily decided upon and apparently was above the minimum effective dosage.

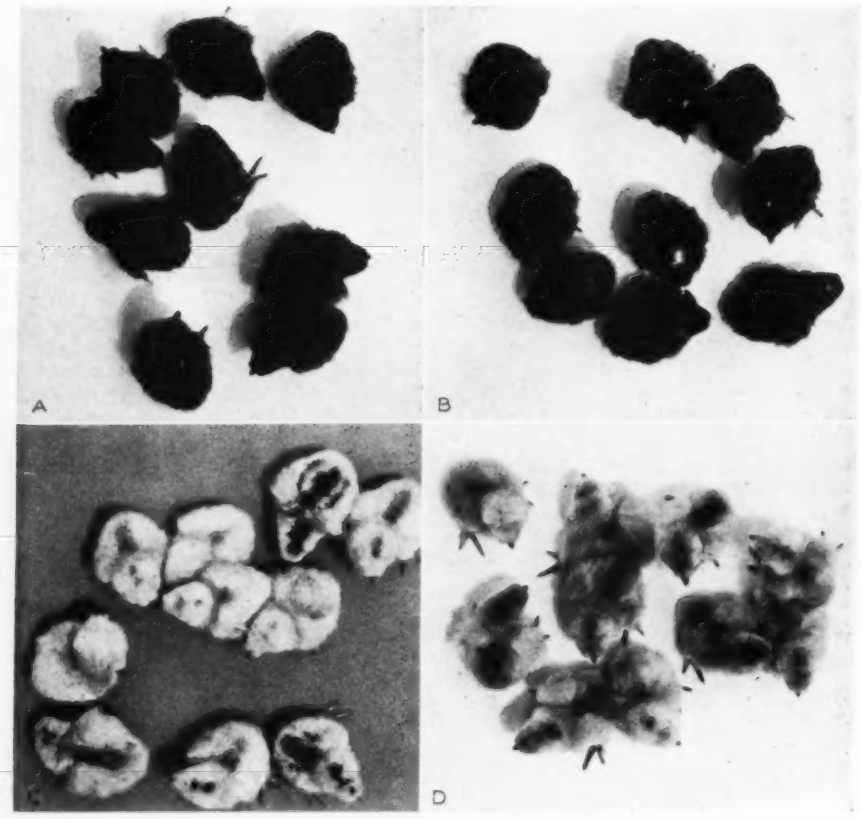
In order to give the insemination technic a further test, White Silky females, unmated for 32 days, were artificially inseminated five afternoons each week with 0.2 c.c. of semen obtained from F_1 males (Rhode Island Red ♂ × Barred Plymouth Rock ♀). These experiments with the new method of artificial insemination gave excellent results, producing 97 per cent fertility and 82 per cent hatchability of fertile eggs.

The Progeny of the Artificially Inseminated Hens

Barred, black, columbian, and red chicks were obtained from both F_1 pullets (White Silky ♂ × R. I. Red ♀) and the White Silky hens which were artificially inseminated by semen from the F_1 males (Rhode Island Red ♂ × Barred Plymouth Rock ♀). These results were to be expected since the crossbred males were heterozygous for barring, black, and silver and both the crossbred pullets and White Silky hens were non-silvers (golds).

None of the chicks from the crossbred pullets was reared. A record of the observations made at ten weeks of age on the chicks produced by the artificially inseminated White Silky hens showed the unmistakable intermediate characteristics in size, crest and shank feathering that would be expected from this cross. The chicks from this artificial mating showed good viability. Of 92 chicks placed on the growing range, 89 were alive at 10 weeks.

The fertility and hatchability of the two artificial matings previously described are shown in Table I, together with the results of natural matings in which the relative differences in body weights are apparently not great enough



FOUR DOWN COLORS FROM ARTIFICIAL MATINGS

Figure 15

When the F_1 male and Silky female (Figure 4) were mated by artificial insemination four types of chicks were obtained as expected: Black (*A*), barred, (*B*), Columbian (*C*) and red (*D*). No other color types were obtained in any of these matings. This result is in accordance with Mendelian expectation, and serves as a check on the method.

to have an adverse effect on fertility. The body weights of the males and females used in each mating are included.

The artificially inseminated matings in Table I compare favorably in fertility and hatchability with the natural matings shown in this table. There is little difference in fertility in matings 1, 2, 3, and 4, the first two of which are the artificial matings. A weighted average of hatchability of these artificial and natural matings also shows very little difference, 82.6 per cent of the fertile eggs from the artificially inseminated matings producing chicks, while 81.1 per cent of the fertile eggs from the natural matings (3 and 4) hatched. It will be noted that although the males in matings 3 and 4 weigh from 50 to 70 per cent more than the females, this difference in weight apparently has no adverse effect on fertility. These results agree with those obtained by breeders of the standard breeds and varieties of poultry. Good fertility is

obtained by practical breeders, for example, from matings of cocks of the American class with pullets of this class although the standard weights of the cocks are from 55 to 65 per cent greater than the pullets.

Fertility in natural matings appeared to decline somewhat, however, when the body weight of the larger mate was much more than 70 per cent greater than that of the smaller one, as shown in three backcross matings (not included in tables) where the larger mate weighed 90 per cent more than the smaller one. When F_1 males (W. Silky ♂ × Rhode Island Red ♀) weighing 1,600 grams were mated to Rhode Island Red females weighing 3,025 grams, the fertility of the eggs produced was reduced from 85 to 65 per cent. The F_1 males used in these matings had previously averaged 90 per cent fertility in F_1 matings.

When the difference in body weights between mates increased to 150 per cent a further decline in fertility was observed, as shown in the following matings. From four matings of White Silky males, 1,240 grams, × Rhode Island Red females, 3,120 grams, only five per cent of the eggs were fertile. These White Silky males had been previously mated to White Silky females and had given 85 to 90 per cent fertility.

A still greater difference in body weights was found in matings of White and Black Rose Comb Bantams with fowls of the American class. In these matings the body weights of the large fowls were about 400 per cent greater than the body weights of the bantams. When Barred Plymouth Rock males, 3,434 grams, were mated to Rose Comb Black Bantam females, 826 grams, no fertile eggs were obtained. In a reciprocal mating of Rose Comb Black Bantam males, 729 grams, × Barred Plymouth Rock females, 3,038 grams, there was also no fertility. Again when Rose Comb White Bantam cocks, 850 grams, were mated to White Wyandotte females, 2,950 grams, no fertile eggs were produced. Additional matings of White Wyandotte males with Rose Comb White Bantam females also produced infertile eggs. The complete absence of fertility in the Rose Comb Bantam × large fowl matings should undoubtedly be ascribed to the wide difference in body weights of the birds mated, because when both bantams and large fowls were mated *inter se* good fertility was obtained.

The results of these three groups of matings, therefore, may be briefly summarized by stating that increasing differences in body weights between the birds mated resulted in a consistent decrease in fertility. The matings in which the body weights of the larger mates were 90 per cent greater than those of the smaller mates produced 65 per cent fertility. The matings in which the body weights of the larger mates were 250 per cent greater than those of the smaller mates gave 5 per cent fertility. And, finally, when the body weights of the larger mates were 400 per cent greater than those of the

Table I. Comparison of results of artificial matings with those of natural matings.

Matings	Weight records				Hatching records		
	Males		Females		Number eggs set	Percent fertile	Percent fertile hatched
	Number	Av. body weight grams	Number	Av. body weight grams			
Artificial							
1. F_1 (R.I.R.♂ × B.P.R.♀) × White Silky♀♀	7	3,374	11	988	835	97.1	88.9
2. F_1 (R.I.R.♂ × B.P.R.♀) × F_1 ♀♀ (W. Silky ♂ × R.I.R.♀)	7	3,374	5	1,604	74	97.3 97.2	68.5 88.6
Weighted average							
Natural							
3. F_1 (W. Silky ♂ × R.I.R.♀) × W. Silky ♀♀	1	1,595	13	909	64	94.0	84.8
4. W. Silky ♂ × F_1 ♀♀(Black Sumatra Bantam ♂ × W. Silky ♀♀)	1	1,600	6	720	93	93.0 93.9	77.8 81.1
Weighted average							

Table II. Fertility in natural matings of the same White Wyandotte male at different ages and body weights.

Matings	Weight records			Hatching records		
	Body weights of male grams	No. of females	Av. body weight of females grams	Number eggs set	Percent fertile	Percent fertile hatched
White Wyandotte ♂ C-376						
5. Age 20-30 weeks × White Silky ♀♀	1,680-80 wks. 2,510-30 wks.	12	949	184	89.5	77.4
White Wyandotte ♂ C-376						
6. Age 30-46 weeks × White Silky ♀♀	3,475-30 wks.	12	919	109	2.7	50.0

Table III. Fertility in artificial and natural matings in which the relative differences in body weights are approximately equivalent.

Matings	Weight records				Hatching records		
	Males		Females		Number eggs set	Percent fertile	Percent fertile hatched
	Number	Av. body weight grams	Number	Av. body weight grams			
Artificial							
7. F_1 (R.I.R.♂ × B.P.R.♀) × White Silky ♀♀	7	3,374	11	988	835	97.1	88.9
Natural							
8. W. Wyandotte ♂ × White Silky ♀♀	1	3,475	12	919	109	2.7	50.0
9. W. Wyandotte ♂ × White Rose Comb Bantam ♀♀	2	3,175	24	810	130	0.0	0.0

smaller mates, the differences in body weights had become so extreme that no fertility at all was obtained.

Further evidence that increasing variance in relative body weights may account for diminishing fertility is given in Table II. The White Wyandotte male used in matings 5 and 6 weighed 1,650 grams at 20 weeks of age when he was first mated to the White Silky females in mating 5. This mating averaged 85 per cent fertility for a 10 week period. At the conclusion of this mating the White Wyandotte male was 30 weeks old and weighed 2,310 grams. The increasing body weight of the male was apparently detrimental to fertility since fertility declined from an average of 85 per cent to about 70 per cent during the last two weeks of this mating. This White Wyandotte male was then mated to Rhode Island Red females for about three months, the fertility from this mating being maintained at about 85 per cent. At the conclusion of this mating the White Wyandotte male weighed 3,475 grams. He was again mated with the White Silky females with which he had been formerly mated. From the latter mating less than four per cent fertility was obtained, as shown in Table II, mating 6. This lessened fertility was undoubtedly related to the increased body weight of the White Wyandotte male.

In general it may be stated that extremely low fertility in natural matings of large and small fowls delays experimental breeding projects and makes them unnecessarily expensive. This difficulty was considered unavoidable, however, since previous experiences in resorting to artificial insemination had likewise resulted in poor fertility, despite the extra time and labor involved.

In Table III the usefulness of the artificial insemination technic is demonstrated when a comparison is made between the results of an artificially inseminated mating and the results of two natural matings in each of which the body weight of the larger mate is about 400 per cent greater than that of the smaller mate, the relative differences in body weights approximating those of the artificial mating.

Although the wide differences in body weights of the natural matings 8 and 9 resulted in quite unsatisfactory fertility, there was no adverse effect on fertility in mating 7, the artificially inseminated mating.

When poor fertility is being obtained from matings of birds differing in body weights, the technic for artificial insemination described in this paper may be used to decided advantage in improving fertility and shortening the time necessary to obtain the desired results. When no fertility at all is obtained, as in some of the matings discussed previously, a satisfactory method of artificial insemination is indispensable.

Summary

A new method of artificial insemination which has proved quite satisfactory has been devised. It consists in the exposure of the orifice of the oviduct for the direct reception of the semen.

A comparison of the results of artificial matings, using the new method, with the results of natural matings indicates that the fertility and hatchability of artificial matings are fully as good as those of natural matings in which the difference in the body weights of the birds mated is not too great.

A wide difference in body weights between mates is a factor in lowering fertility, which appears to decline considerably in natural matings, when the body weight of the larger mate becomes much greater than twice that of the smaller mate or mates. No fertility was obtained in natural matings when the body weight of the larger mate was about four times as great as that of the smaller.

Utilizing the new technic for artificial insemination it was possible to obtain 97 per cent fertility in fowls differing so greatly in body weights that in natural matings four per cent fertility was the maximum obtained.

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Marriage Among the Deaf

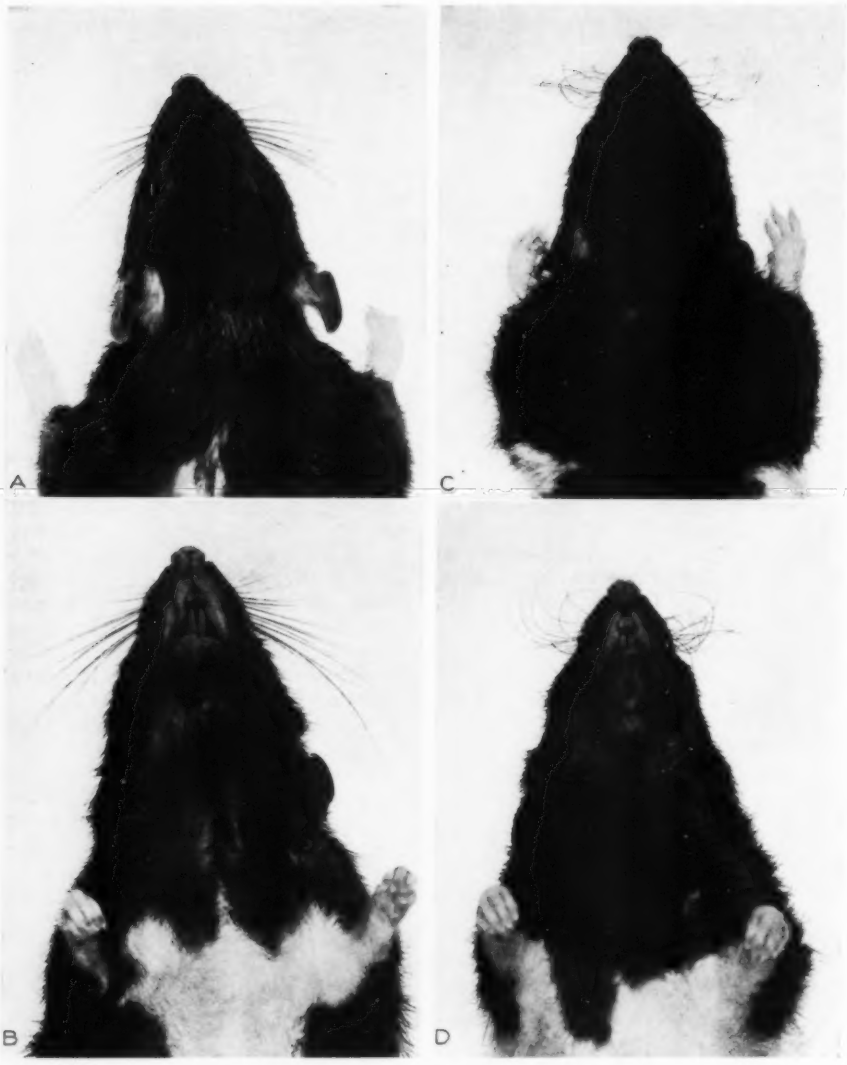
THE August, 1935, number of the *Volta Review,* contains two interesting contributions on inheritance of deafness. One of these is a reprint of an address made over forty years ago by Dr. Alexander Graham Bell, shortly after he had published his "Memoir Upon the Formation of a Deaf Variety of the Human Race." This is of considerable historical interest because of the facts brought out in the second article, in which Dr. Elbert A. Gruver, President of the Volta Bureau, and Superintendent of the Pennsylvania School for the Deaf, reviews the early work on inheritance of deafness and then presents some interesting figures, compiled from Volta Bureau records regarding conditions today:

> In the Pennsylvania School for the Deaf 68 children entered school in 1934. Of this number, 31 were born deaf—again about 50 per cent; 5 have deaf parents, 8 have other deaf children in the family, and 4 have deaf relatives. Of the 535 pupils enrolled in 1934-35, 22 have deaf parents. We are instructing now the grandchildren of some of the former pupils.
>
> Forty-five children entered the Primary Department of the school last fall (1934). Sixteen are reported congenital, 3 before one year of age, 6 before two years and 3 additional reported cause unknown. It is safe to say that almost all of these are congenitally deaf—28 of the 45, or again about 50 per cent: 12 of these 45 had deafness in their families as follows: 1 had 7 deaf relatives, 2 had 5, 2 had 3, 2 had 2 and 5 had 1. Two cases are consanguineous. Thus history repeats itself.

Dr. Gruver discusses the implication of these facts and feels that selective mating of the deaf is continuing in spite of warnings by Dr. Bell and others of the dangers of forming the deaf variety of the human race. The solution suggested of encouraging the marriage of the deaf with people of normal hearing seems rather hazardous to this reviewer. The assumption in such matings is that most forms of deafness being recessive the children will rarely have defective hearing. It is certain that every child of a person suffering from recessive deafness will carry one gene for this defect. The rapid spread of such deafness genes in the population may at the end of a few generations result in considerable increases in genetic deafness. Dr. Gruver concludes with the following thought:

> Probably there is no person, who has lost his hearing, who would willingly bring a child into the world to suffer the same experience. I do not believe that the young people who are contracting these marriages are selfish; I think they are merely uninformed. Either they have never thought anything about the probabilities, or else they have been led to believe there is no danger. Is it not our duty to teach them?
>
> I do not presume to say how we should proceed, except to advise that we make full information available, and that we see that it is in the hands of all deaf or hard of hearing young people at as early an age as possible. For, to quote a comment penciled on the margin of a book at the Volta Bureau, in Dr. Bell's own hand: "It is too late to reason with a man *after* he has fallen in love. He cannot help himself."

R. C.



CURLY$_2$ RATS COMPARED WITH NORMAL

Figure 16

Dorsal and ventral views of normal (*A-B*) and curly$_2$ (*C-D*) Norway rats. The difference in the development of the vibrissae ("whiskers") can be detected at birth, and at all ages the distinction between curly$_2$ and normal is clear-cut and presents no difficulty in classification. In appearance this character is very similar to a curly mutation reported in 1932, but the two curly genes are distinct in inheritance.

CURLY$_2$, A RECENT DOMINANT MUTATION IN THE NORWAY RAT

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University of California, Davis

IN 1932 Dr. King* reported an autosomal dominant mutation which affects the guard hairs and vibrissae of a strain of captive Norway rats. Since this mutant gene causes the hairs to be wavy and somewhat curled, Dr. King called it "curly coat." The curly mutation reported in this paper parallels the "curly coat" mutation so closely in appearance that so far we have been unable to detect any constant morphological difference between the two. However, appropriate test matings demonstrate clearly that the two types are genetically different. Our curly mutation originated in the colony maintained by the Department of Anatomy of the University of California. It was first observed during July, 1933, in a young, black-hooded female at the time of weaning. Both parents and all the litter mates of the original mutant were reported normal by Miss Reistrup, the technician who first observed it. Since this mutant was underweight and unfit for experimental purposes in nutrition, it was discarded. Mr. R. E. Volcani observed the mutant female and obtained permission from Dr. Lepkovsky to keep her. We are indebted to Mr. Volcani for placing the rat at our disposal for genetic analysis.

The new curly character affects the development and expression of the hairs of the coat. In adults, the guard hairs appear to be reduced in number, and possibly in size, and are distinctly curly in character. More of the underfur shows in the curly rats than in normal ones and the general appearance of the coat is curly and rough (Figure 16).

The new character can be diagnosed at birth by the appearance of the vibrissae. Curly rats have short, crooked, or curly vibrissae, which tend to curve posteriorly, while normal rats have longer, straighter vibrissae. When the hair begins to develop on young rats, the curly character may be recognized by a more roughened appearance of the fur.

The new curly character behaves as a dominant in inheritance the same as does Dr. King's curly. The original mutant female was heterozygous for the condition, and produced approximately equal numbers of curly and normal offspring when mated to normal males. The results of the different matings are summarized in Table I. A total of 191 offspring was produced from three different types of matings. Heterozygous curly females mated to normal males produced a total of 70 classified offspring, approximately one-half of which were curly and one-half normal. Reciprocal matings, normal females with heterozygous curly males, produced 79 offspring, one-half of which were curly and one-half normal, with an equal proportion of males and females in the curly and normal classes, showing that curly$_2$ is not sex-linked.

The mating of heterozygous curly females with heterozygous curly males produced a total of 42 offspring, approximately three-fourths of which were curly and one-fourth normal. Sexes were distributed equally in the two classes. Curly is caused by one dominant autosomal gene. Homozygous dominant males and females have been identified. Furthermore, extracted normal (non-curly) from curly parents breed true for the non-curly condition.

Relationship Between Curly Genes

In order to determine the relationship of our curly mutant with "curly coat" as reported from the Wister Institute, we exchanged stock with Dr.

*KING, HELEN DEAN, 1932. Mutations in a strain of captive gray Norway rats. *Proc. Sixth Inter. Cong. Gen.*, 2; 108-110.

King, and suitable tests were made to test the relationship. Rats known to be homozygous for our curly were bred to rats known to be homozygous for Dr. King's "curly coat." The F_1 progeny were all curly and did not differ appreciably from either parental stock. The F_1 progeny were then used in two tyes of matings. In the first type the F_1 hybrids were mated to normal rats. The results are tabulated in Table II. When the F_1 males were bred to normal females, six litters consisting of a total of 41 curly and 17 normal progeny were produced. The reciprocal mating, F_1 females to normal males, produced 5 litters consisting of 37 curly and 12 normal rats. If the results of these two matings are combined we find that 78 curly and 29 normal offspring were produced. Now if our curly mutation were identical with Dr. King's "curly coat" mutation, the F_1 progeny should have been homozygous for curly, and therefore should have bred true for the curly character. However, the fact that the F_1 progeny were not homozygous, and produced three times as many curly offspring as normal offspring when mated to normal (non-curly) rats, is conclusive proof that our curly mutation is genetically different from Dr. King's "curly coat" and is located in another linkage group.

This conclusion was corroborated by the second type of mating, wherein F_1 hybrids produced by crossing the two kinds of curly mutants were bred together to produce an F_2 population. Four litters, comprising a total of 42 curly and 3 normal individuals, were produced. On the basis of two factor pairs segregating and operating as duplicate genes, one should have expected 42.2 curly and 2.8 normal individuals. This is a perfect fit with the actual results.

Since our curly mutation is distinct from the one Dr. King previously reported we will use the term "curly$_2$" to designate our mutant and the symbol Cu_2 for the gene. We shall refer to Dr. King's mutant as "curly$_1$" and Cu_1 for the genetic symbol. On this basis the genetic constitution of our curly rats was $cu_1cu_1Cu_2Cu_2$. That of Dr. King's was $Cu_1Cu_1cu_2cu_2$, and that of the F_1 obtained by crossing the two curly races, $Cu_1cu_1Cu_2cu_2$. As yet we have not identified any homozygous double dominant ($Cu_1Cu_1Cu_2Cu_2$) individuals, though in all probability some have been produced although they may be difficult to identify.

Table I. Results obtained from three types of matings involving the curly$_2$ mutation.

Mating No.	Type of Mating	Offspring: Curly ♂	Curly ♀	Normal ♂	Normal ♀	Total offspring	Total litters	Average size of litters
1	Cu_2cu_2 ♀♀ x cu_2cu_2 ♂♂	13	17	15	25	70*	8	9
			30		40			
	Expected		35		35			
2	cu_2cu_2 ♀♀ x Cu_2cu_2 ♂♂	24	14	21	20	79	9	8.7
			38		41			
	Expected		39.5		39.5			
1 & 2 combined		37	31	36	45			
			68		81			
			74.5		74.5			
3	Cu_2cu_2 ♀♀ x Cu_2cu_2 ♂♂	14	15	8	5	42	4	7
			29		13			
	Expected		31.5		10.5			

*Two died without classification.

Table II. Results of mating F_1 hybrids produced from crossing the two curly races, and among themselves.

Mating No.	Type of mating		Offspring: Curly	Normal
1	$F_1Cu_1cu_1$ Cu_2cu_2 ♂♂ x cu_1cu_1 cu_2cu_2 (normal) ♀♀		41	17
		Expected	43.5	14.5
2	$F_1Cu_1cu_1$ Cu_2cu_2 ♀♀ x cu_1cu_1 cu_2cu_2 (normal) ♂♂		37	12
		Expected	36.75	12.25
1 & 2 combined		Observed	78	29
		Expected	80.25	26.75
3	$F_1Cu_1cu_1$ Cu_2cu_2 ♂♂ x $F_1Cu_1cu_1$ Cu_2cu_2 ♀♀		42	3
		Expected	42.2	2.8

Size, Vigor and Fecundity

There appears to be no marked difference in size or vigor of curly$_2$ rats when compared with their normal sibs. This applies to young, growing, and mature rats. The fecundity of curly$_2$ females appears to be equal to that of the normal females of the colony. Forty-nine litters produced from heterozygous females averaged 9.1 young per litter. Eleven litters from homozygous curly$_2$ females averaged 8.6 young per litter. The mean litter size for the whole normal colony is slightly over 9.

Complete linkage tests of the curly$_2$ gene with the other mutant types are now in progress.

Summary

Curly$_2$ is a dominant autosomal unit-character of the Normay rat. It is phenotypically indistinguishable but genetically different from Dr. King's curly$_1$.

GENES AND EMOTIONS OF MEN

Reviews of Three Recent Books on Human Heredity and Environment

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STUDIES IN RAPPORT

THE title of this book* is altogether misleading. It affords no introduction to the text which, according to Dr. W. A. White's foreword, "is a study of the emotional relations between individuals who are functioning as a social group, or . . . the cross-currents of emotion as they play back and forth between individuals" (p. xi). The emotion studied is that of like-dislike. The author (correlatively) "develops a technique for a process of classification which is calculated, among other things, to bring individuals together who are capable of harmonious inter-personal relationships, thus creating a social group which can function at the maximum efficiency and with the minimum of disruptive tendencies and processes" (p. xii). The book might be dismissed from further consideration in a publication devoted to genetics and eugenics, were it not that it has received a rather favorable reception in certain quarters, and that some of its methods and conclusions may be evoked in future "social experimentation." For that reason it seems worth while to devote more space to this book than would otherwise be the case.

The research, which is vaguely planned and poorly presented, covers data secured from children in a public school, a private school, and a state training school for girls. Some of these subjects were given a "sociometric test" which was, or was not, followed by a test for "spontaneability." The "sociometric test" is the basis on which the research rests; the test for spontaneity is offered to guide later social experimentation for a new order.

To be more specific, the procedure was as follows: "Our guiding principle in the research has been from the start, after we had decided working in an unexplored territory, to let the direction and the expansion of the research grow out of the situation" (p. 91). "The sociometric test requires an individual to choose his associates for any group of which he is or might become a member" (p. 11). This "test" is directed toward choice of housemother, of housemates and chums, of co-workers, and of cottage groups. These choices are elaborately pictorialized by colored lines, extending between chooser and chosen (or rejected). In the spontaneity tests, the subject improvises a standard life situation to his own satisfaction. He is told, for example, to "throw yourself into the state of anger" (p. 195). The test, it is claimed, "analyzed emotional, social, and vocational abilities" (p. 271). Proof that such is the case is conspicuously lacking.

The training-school girls furnished the bulk of data for the report. At no time does the author describe clearly or in detail the precise make-up of any of the many groups analyzed, other than to assign a cottage number. He speaks casually of race and nationality differences, but rarely does he let the reader know whether the group he refers to is white or colored, or what its particular characteristics are. And in regard to socio-economic make-up, he sets down this surprising observation with respect to committed girls: "They are sent in from every part of N. Y. State by the courts; they are a cross-section of the nationality and social groups of New York" (p. 69). (Any elementary

*Moreno, J. L. *Who Shall Survive?* A New Approach to the Problem of Human Interrelations. Pp. 440. $4.00. Nervous and Mental Disease Publishing Co., Washington. 1935.

sociologist could tell Dr. Moreno that children committed through New York courts are *not* drawn from all social groups; much less do those in a state institution for children represent a "social cross-section" of any state.)

The investigator makes repeated demands on the reader's scientific tolerances. He refers to his "sociometric test" as though it possessed an infallibility never yet accorded the most carefully standardized psychological test. Dr. Moreno's "test" is simply an offer of choice—of five choices—to the individual as to which individuals or group he wishes in the future to live with, work with, or play with. All five choices of mates are not always exhausted by the chooser. The persons chosen are later interviewed and their reaction to their choosers noted. The current which passes negatively or positively between any two people (or groups) is called a "tele." Needless to say the discovery is made that we are not always loved or sought by those whom we love or would seek!

The investigator's talents are best revealed in his pictorial representation schemes of these affective currents, or "teles." A love that goes out earns a red line; a hate that returns becomes black. "Teles" between any two individuals or groups may be red, black, or half-black-half-red. Dr. Moreno also discovers with surprise the presence of "key" individuals, that is, persons who have a large, if inarticulate, following (which translated into "power" may be something to be reckoned with). He notes also the occurrence of "isolates," that is, those none-too-rare individuals whom nobody loves. A "key" individual is strong; an "isolate" weak. There is also discovered the presence of "chains" (four to six or more people who form a closed circle, whose activities and line-up in the outside world might go by the name of "gang"). Acceptances and rejections of individuals from cottage to cottage are revealed by many red, green, and black lines, which crisscross in beautiful, lacy networks on paper. Some cottages, housemothers, jobs, and play activities are found to be more popular than are others. These discoveries have all been made by asking people to tell whom they like or dislike, and by transcribing their responses on a floor plan.

The author's solution for the psychological salvation of group living is to have people live, play, and work with those individuals or groups whom they choose to live with, etc. Moreno cheerfully disregards the important implications of the fact that it is possible that at the time of having to choose the choosers' acquaintance with the alternative groups may have been new or definitely restricted. This social recommendation might be worth applying to society at large if only we could regulate, through personal choice, the particular companions with whom we must live, work and associate in all of our various interpersonal relationships. It might be made to work in some measure if we could be sure that our choice of today would hold for tomorrow. People then would never be dismissed from their jobs or divorced or forsaken or socially ostracised. It might even be made to work for a limited time if but to mention names were ever likely to be an open sesame to change in associates with change in experience and outlook.

But even in a training school how can it work as this reporter in his enthusiasm would have us believe that it will? His technique assumes that children can make accurate and lasting choices of housemothers at sight, and from a distance, or known through hearsay only. How else can a child living in one cottage in an institution know whether she is going to be able to live permanently in "harmonious interrelationship" with a housemother in another cottage, or with one or more members of a group outside of her own? The author speaks of the likes and dislikes of these training-school girls for their housemothers and mates as though committed girls had equal opportunity with free citizens outside to form their friendships (p. 103). In all custodial institutions, social interac-

tion is artifically controlled and restricted; necessarily so. He notes the waning of choices as later choices are given, but he does not sense the limitations imposed on the girls' opportunities to become intimately acquainted with 500 other inmates. He does not even consider the domination effect which different housemothers can have on the choices given by their charges, who are required to set down these choices in writing, over their signatures. Yet the author's recommendations for society must rest on the results obtained from these data, the validity of which is open to much serious question.

Analogies are drawn between the "institution runaway" and the "problem of migration" (p. 31), on the naive assumption that girls in such a correctional school do not run away because they have no place to go or because the psychological forces attracting them to the institution are so strong that they do not want to run away to freedom (p. 204)! Perhaps in his creative preoccupation the author did not observe locked doors, night watchmen, or barbed-wire fences; nor did he hear of punishments and ostracism visited upon that greatest of all offenders in such a school—the (rather easily caught) returned runaway.

The English of the text makes painful reading. Coined words, wrongly used words, mistakes in grammar and sentence structure may call for tolerance, even sympathy, for a foreigner's difficulties with English, but a report which is to attain the dignity of publication as a scientific monograph, surely ought to conform to elementary English usage. It is a great pity that one or more of the sixty-odd people to whom the author makes formal acknowledgment of help (pp. 434-435) could not have come to his rescue in the interests of verbal purity and of clarity. Infringements of the following kind occur on every page: "The ground . . . may lay in the first stage" (p. 62); "It apparently depends also upon whom are cut out" (p. 208); "radiated into all directions" (p. 19); "The opportunity to interject into the homestead project, besides agricultural and economic, also psychological planning was given" (p. 20); "pieces caught in the machine to an extent necessitating the forewoman to halt the steam roller to remove them" (p. 113); "There are millions of individuals among us, who, when they love a woman, at least five are ahead of him who are more attractive to her" (p. 250).

"Who Shall Survive?" This question, asked so intriguingly in the title is forgotten until it again appears as a chapter heading at the end of the book. Chapter 23 is not a summary of the 362 pages preceding it, but a rumination of ideas likely to occur to any thinking person of the 1930's. On page 366, one gathers that the author's "study of the integrating and disrupting forces in the development of society, by what means they operate and by what techniques they can be controlled" has disclosed characteristic "inner disturbances as a permanent feature of social organization," but the presentation of these disrupting forces or the revelation of their cause or control is confined to the likes-dislikes data revealed by the sociometric test.

There is, of course, no question that our emotional attitudes toward and from our fellow men, separately and collectively, play a large part in our happiness and unhappiness, and it would invariably be helpful to understand in any given relationship the factors underlying the attitude. But to assume that one can offer a formula for determining the "emotional structure" so prettily depicted in Dr. Moreno's red and green diagrams is to assume an astounding simplicity of emotions as well as a static universe of attitudes which has no existence in fact.

One knows *a priori* that there is an invisible structure of love and hate and various emotional hues in between, underlying social groups and individual relationships, but one cannot and never will be able to reveal this wealth of emotional coloring and complexity by straight red and green and black lines. In his ambition to pictorialize inter-

personal relations, Dr. Moreno has overlooked too many things; the resistance, conscious and unconscious, of personality to reveal itself in its true form; the instability of emotion and attitude; their alteration and extension with experience; and above all, in a training-school situation, the "halo" effects injected into admissions made by the committed individuals accustomed to playing up to staff officers and official investigators.

In his recommendations for an ideal social set-up in the world at large, the author constantly assumes a cohesion and a permanency for the likes and dislikes expressed by this choice test which he holds would be adequate for permanent group formations. He goes further; he draws eugenic implications! "Some groups classified today as unfit for propagation may be found unfit when in relation to certain groups, but fit in relation to other groups" (p. 369).

And what are the contributions of this vast piece of work which has utilized the services of so many workers and subjects? At times one gets the feeling that the author is on the verge of an idea which, if one could thread his way through the mess of verbiage which enshrouds it, would be worthy of propagation. The main finding seems to be that some people like each other and that some do not, or what is even sadder, that we give our love to people who respond indifferently or negatively to our precious gift, and who in turn may meet with a similar fate at the hands of some one else. If we could live, play, and work with people whom we like and who like us in turn, life would be rosier. Perhaps the most valuable contribution of all, however, is the elaborately conceived system of codes and formulae for setting down "psychological cross currents" of love and hate. They are very pretty to look at on paper; and they do save words, which should appeal especially to the lovers of this world, if not to the haters.

GLADYS C. SCHWESINGER

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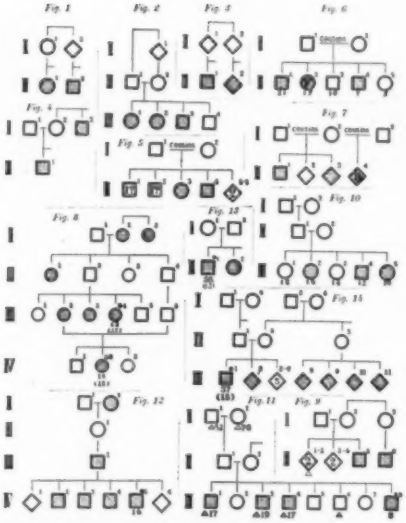
GENETICS OF THE JAPANESE

THIS compilation,* by a professor of zoology in the Kyoto Imperial University, of diseases and abnormalities found in the Japanese race, should be welcomed alike by the student of medical genetics and of racial anthropology. Many of the 741 pedigrees are fragmentary and for many anomalies only one pedigree is furnished but, as the compiler states in his introduction, they should be of value if only as raw materials for further research.

The pedigrees here published represent, in the main, a stage in the genetics of the Japanese race comparable to that reached for the white race when Davenport published his *Heredity in Relation to Eugenics* in 1911. These pedigrees have been painstakingly gathered from a wide range of journals, 91 to be exact; even though incomplete, and for the most part by-products of research in other lines of medical science, their former inaccessibility to Occidental workers, because of the language in which they have been reported, should make this report valuable to all students of human genetics. The author's general conclusions, too, have direct bearing on the vexed question of racial resemblances and differences. Shall we find the Japanese our first cousins or even "brothers under the skin?" Ideas to be derived from study of this work might well serve as the starting-point for further researches in this all-important field, particularly since as a nation we have decreed their exclusion as immigrants and now are inclined to decry their successful intrusion into other lands.

From his analysis, Komai finds some eighty diseases and anomalies to be hereditary. Since he cites only two

*KOMAI, TAKU. Contributions to the Genetics of the Japanese Race I. Pedigrees of Hereditary Diseases found in the Japanese Race. Pp 51. Plates 84.



PEDIGREE OF EAR AND MUSCLE DEFECTS

Figure 17

Reduced reproduction of Komai's Plate 64, showing pedigrees of deaf mutism (Figs. 1-7), of otosclerosis (Fig. 8), and of progressive muscular dystrophy (Figs. 9-14). The publication contains 84 pages of charts showing inheritance of various deviations from the normal in the Japanese race. Numbers below symbols indicate age at time of observation—or when in brackets, age at time of onset of disease. A "delta" before number indicates age at death.

British workers, no other European authorities, and only two Americans, his opportunities for comparison are decidedlv limited and his conclusions as to the genetic nature of these diseases are to be taken with some reservation. Moreover it is significant that he bears out rather than contradicts the conclusions, however tentative, that have been reached by workers in the Occident.

Among diseases found to be dominant, Komai names: cataract, glaucoma, otosclerosis, tuberous cerebral sclerosis and myoclonus epilepsy. Recessives are: diabetes mellitus, microcephaly, myopia, hyperopia, deaf-mutism and Friedrich's ataxia. Nystagmus, haemophilia, progressive muscular dystrophy, red-green color blindness, and congenital night-blindness show sex-linked inheritance, with or without a modifying gene. Dipsomania, mental defect, and the psychoses furnish only nine pedigrees. Since the compiler expressly states that his list is "nearly comprehensive," are we to infer from these omissions that we, of the so-called "dominant races" have a monopoly of such deviations?

Similarities in Defective Genes

Passing now to Komai's general conclusions we note that "there is very little difference either in the kinds of disease or in the modes of transmission" between oriental and occidental races. As instances of rare exceptions he mentions Oguchi's disease, which is much rarer in Europeans than in Japanese, and Huntington's chorea, no authentic case of which is known among the Japanese. "We are thus much more impressed with the similarity than the dissimilarity of the kind and distribution of those morbid genes among the two races. It is true that, strictly speaking, in order to be sure about the identity of the genes causing diseases of similar symptoms in different races, the hybrids between the two races should be examined as to the point in question. This is a virgin field of human genetics which awaits intensive inquiry in future."

Blue Eyes Lacking

Of especial interest are the brief observations on Japanese and Western Races in respect to "normal" characters. For, in sharp contrast with the morbid genes, the former show considerable differences in kind and frequency in the different races. The Japanese are lacking in the gene for blue eyes while the gene for the Mongolian birth mark is of universal occurrence among them. The double eye-lids to be found in practically every European occur in only 40-50% of the Japanese and the reverse proportion is true for certain blood-types. As for other characteristics separating human races, generally believed to be more important, namely stature, body build,

skin and hair color, temperament, the distinction is less clear-cut. While it is no doubt true that some features of racial differentiation have adaptive significance, these are, to the mind of the compiler, exceptional cases and do not invalidate the belief that the different races are separated mainly by differences in genes that are normal in contradistinction to those that are pathological. How such differences in the distribution of these "normal" genes have been brought about is a difficult question. The processes involved would appear to be extremely complicated. Differences in the rate of mutation may be one of the leading causes, and undoubtedly isolation for many thousand generations has had much to do with the situation.

Regarding the discussion as to whether human racial differentiation is of specific or sub-specific rank, such distinctions are identical in principle with those of other animals. If this is so, then what has been stated as to the nature of differentiation among human races would be applicable to the distinctions separating such subspecies or species. Thus the study of human genetics bids fair to throw light on the fundamental problem of organic evolution, and genetic investigation of "normal" characters seems to contribute to this end more than the study of pathological characters.

WILHELMINE E. KEY.

THE EUGENIC DR. JEKYLL AND MR. HYDE

IF the next generation could be allowed the privilege of choosing its parents the future of mankind might be somewhat more hopeful than it is under the present dispensation, where potential parents elect themselves to the job without, on the average, much thought as to their fitness for the altogether perplexing venture on which they are embarking. Similarly, if the eugenic movement could have become somewhat more personified and could have been given the privilege of choosing its friends and champions on various occasions, the present status of the movement might be far ahead of where it is today.

Possibly enlightened "friend control" could do as much for such a budding social infant (Eugenics) as we are told that enlightened birth control might do for the entire human race. These speculations have been induced by a recent "boost" which seems to be another of those blows of the Brutus type which have a way of reflecting on the mental acuity of all proponents of race betterment.* Perhaps the fact that in this venture in "eugenic enlightenment," the American Genetic Association experiment in fostering a wider appreciation of the important discoveries in the field of genetics is branded as "ridiculous" is one reason why the reviewer feels so strongly about the matter. But even without such a stimulus the book may well be commended as a type specimen of muddled thinking. In one respect it is perhaps a unique exhibit because the author is not alone to blame in this instance. The venture is made doubly or even triply absurd or iniquitous (depending on how we look at it) because it bears the blessing of an "Introductory chapter" and a double barrelled "Foreword" in which three other authorities display a most surprising lack of grasp of the subject which they attempt to discuss.

The Introduction is penned by Chancellor H. P. Whidden, D.D., LL.D., D.C.L., of McMaster University. In this we learn:

> Books and articles have appeared from time to time during the past thirty years setting forth in theoretical fashion or in an extremely superficial way the impracticable

*Siegel, Morris. *Constructive Eugenics and Rational Marriage.* With an Introductory Word by Chancellor H. P. Whidden, McMaster University, D.D., LL.D., D.C.L.; and a Foreword by J. R. Parry, B.A., M.B., F.R.C.S. Canada, and J. P. Morton, M.B., F.R.C.S. Edinburgh, F.R.C.S. Canada. Pp. 196, $2.50. McClelland & Stewart, Ltd., Toronto. 1934.

ideas concerning segregation, adaptation, mating, and control. But this book gives us in a clear cut, sane, constructive manner the opinions of one who has read, studied, investigated, and reflected long enough to reach important conclusions for himself. These he has presented in the following pages, having in mind the intelligence of the average reader, especially the younger men and women of today.

In the Foreword, the joint brain child of John R. Parry, B.A., M.B., F.R.C.S., (Canada), and John P. Morton, M.B., F.R.C.S. (Edinburgh), F.R.C.S., (Canada), we learn further of the deplorable situation that confronts the world for lack of "lowbrow information on eugenics":

That there is a great paucity of literature, readable literature, on the subject of eugenics is to be deplored. We emphasize 'readable literature' because there is no dearth of highbrow (if one may be permitted to use that expression) essays, written by theorizing professors. But one in a search through the best of our libraries would be unable to find a book to hand to his son or daughter on the subject, which out-ranks all others as a help in formulating a programme for a happy life; namely, eugenics. This has indeed been a sad state of affairs. There are plenty of volumes on how to make ends meet with a small income. One finds there, that a happy home depends on a beautiful rose-garden, or perhaps a modern convenient kitchen. But try to find anything truly readable, on the most important problem facing the young people today—eugenics—and it is not there.

In this book Doctor Siegel seems to have bridged the gap. Here is a book which can be read by the boy or girl of sixteen years with interest; a book that all parents, physicians, clergymen and teachers should be familiar with; a book, which if read widely, should prevent in the future many tragedies of human mating; a book which should be the parent's text book.

Divorced from Doctor Siegel's text one should perhaps be cautious in quarreling with these statements. Perhaps everything that has been written on the subject is "theoretical," "superficial," "impracticable," "highbrow." It is only when we consider the book to which these encomiums refer that we can really grasp their astonishing nature. One can conceive of a great presentation of the subject of eugenics that so far dwarfs existing discussions as to justify such comparisons. But to make these claims regarding a hodge-podge of muddled thinking and misinformation can most charitably be laid only to the complete and blissful ignorance of these gentlemen regarding the literature they have so glibly weighed in the balance and found wanting.

Perhaps a statement of such strong convictions should be documented by an abundance of evidence, but the exigencies of space forbid more than a single example. The problem of dissemination of defective genes in the population is admittedly a serious one in any comprehensive program of race betterment. When on pages 57 and 60 we read the following statement we may well feel that Doctor Siegel is on the right track, though far from accurate:

* * * * It is safe though to state that heredity is responsible for more cases of insanity than all other causes combined. The insane person himself is less a menace from a eugenic standpoint, than is his immediate relative. People fear the insane, therefore they have less chance to propagate than their normal brothers or sisters who may be the bearers of the same taint or defect. Hereditary insanity, in all its forms, is of a recessive character.

* * * * *

This brings to face the task that the eugenist has to cope with. The great number of defectives and degenerates among us is alarming. The worst feature of the situation is that these defectives are constantly polluting our sound and good stocks. The number of defectives in proportion to sound stock is steadily on the up-grade. They increase at a rapid rate. What are we going to do about it? At present they are a terrible menace to society. Are we going to sit idly by and let the monster grow and flourish until he destroys organized humanity? No! There exists a serious pathological condition, in the fabric of our society, and we must use our minds, skill and effort to remedy it. And remedy it we must. It is our most sacred obligation to ourselves, to our children and to the human race. We must devise methods that will effect a complete remedy. Half measures will not suffice. The monster has assumed tremendous growth, and tremendous effort is required to curb its malignant strength.

Even though we may feel that the picture is somewhat overdrawn, we must admit that the problem is one of transcendent importance. But imagine our astonishment a little farther on to read the following under the title "Constructive Eugenics" (pages 121-122). A history of one of Siegel's emotionally unstable patients in considerable detail concludes as follows (*Italics the reviewer's*):

* * * * After a stay in the hospital for three months she made a fair recovery. She was able to go back to work, although at times she felt quite tired and exhausted. A doctor advised her to settle down and get married. She did. She has now two girls, one child is seven, the other six years old. The children are greatly retarded, both physically and mentally. The patient's condition is now worse than ever. She is always under the doctor's care.

Family history cannot be obtained. She refuses to give information. I know her sister, however, who, while apparently clever and quite attractive, is grossly immoral, although not a professional prostitute. Studying the husband's pedigree, I found there a serious neurotic taint. His mother died in an asylum. An aunt of his was insane and died at the age of twenty-five.

The future prospects of this family are quite gloomy. The onus rests with the physician who so unwisely advised the girl to get married. *This lady might have been the mother of normal children had she been properly advised before choosing her mate. She should have been advised, that there exists a serious neurotic taint in her family, and that she must (for the sake of her offspring) choose a husband whose pedigree proves him to be reasonably free from the same taint. But she was left unguided and made an unlucky choice.*

Had she been warned in time of the danger that may await her offspring, there would have been no children in this family. But there was no one to warn her. She is now fully aware of the danger and is using contraceptives.

I can cite case after case where blunders of similar nature, and even more serious, were made by reputable physicians to the detriment of society and race.

Where, Dr. Siegel, is "our sacred obligation, to ourselves, to our children, and to the human race?" After the reader's amazement has subsided a suspicion may creep into his brain that there is really not one Doctor Siegel but two. He can envision a Doctor Jekyll Siegel busily engaged in doing what he can to help the eugenist in his major task of preventing the pollution of sound stock with defective genes bearing always in mind that "half measures will not suffice." Out of a corner of his mind's eye he may be able to glimpse Mr. Hyde Siegel busily engaged in advising neurotic ladies to marry wisely "a husband reasonably free from the same taint" and gleefully assuring her that if she does this everything will be "hunkydory." We see Mr. Hyde Siegel holding forth on the excellent quality of the offspring from such a union but changing the subject hastily when his increasingly befuddled audience, of average readers and young minds, starts asking about the children's children and *their* grandchildren.

It is too much to hope that we can stem the tide of less-than-mediocre books on many subjects. It is almost as hard as eliminating recessive genes. Paper and pencils are cheap and publishers sometimes strangely optimistic. Until eugenical enlightenment has progressed to the point where no university chancellor could be found willing to attach his name to a published statement that such a book is "clear cut, sane and constructive," hardly a beginning has been made. That all the excellent presentations on the subject of quantity and quality of population, birth rate trends, as well as the more frankly eugenic treatises such as Popenoe's "Applied Eugenics" and the monumental work of Bauer, Fisher, and Lenz should be disposed of as "extremely superficial," "impracticable ideas," is only less astonishing than that this eugenically schizophrenic opus should be described as "clear cut, sane and constructive." Did Chancellor Wheddon take the trouble to read Doctor Siegel? Did he ever hear of Darwin's "What is Eugenics?" East's "Biology and Human Affairs," Holmes' "Eugenic Predicament," Guyer's "Being Well Born," Castle's "Heredity and Eugenics" or of dozens of other works on the subject infinitely superior to the one under consideration? If he is not informed on the subject he has been ill advised to endorse a book which is no credit to him or to the institution he represents.

We can only hope that foolish endorsements, like foolish bidding in bridge, ultimately bring their own rewards. If Doctor Siegel's murky efforts at eugenic enlightenment somehow result only in the acquisition by the library of McMaster University of an up-to-date file of publications on eugenics and human genetics it may not have been in vain—but it *is* rather hard on eugenics and on "the average reader."

R. C.

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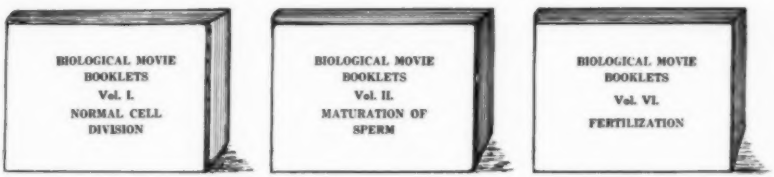

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